

# The Southern Surgeon

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## SOME CARDIOVASCULAR PROBLEMS OF INTEREST TO THE SURGEONS

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Philadelphia

**W**HEN cardiovascular disease or dysfunction is present, the physician and the surgeon will often face the following three problems:

1. Is the circulatory status of the patient good enough to withstand the traumas of an anesthetic and a surgical procedure? That is, will this status appreciably increase the risk of the procedure contemplated?
2. Does disease of the heart and the blood vessels warrant surgical intervention?
3. And last, but not least: Is the condition in question a purely medical condition masquerading as a surgical condition?

Around this framework this presentation will be built.

It is only proper to state at the outset the difficulty of laying down rules generally applicable. Each patient represents an individual problem, and it is only fair to say that no unanimity of opinion may be expected, for the range of our subjective evaluation is wide, and the unexpected happens almost every day.

Given, then, a patient affected with cardiovascular disease, we should start out with the realization of the different degrees of functional capacity. Such functional capacity is, in the first line, determined by obtaining an accurate and detailed subjective story of the patient's response to effort. Two symptoms should always be investigated. The first is true anginal pain. There is no particular diagnostic difficulty in a typical case with its substernal squeezing constriction. However, the anginal pain may be occasionally localized exclusively in one hand and wrist; permanent shoulder pain, particularly at the left side, is noted in connection

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with angina pectoris subsequent to cardiac infarction. An investigation will elicit that such pain is aggravated by exertion or excitement. The second symptom is shortness of breath. It need not necessarily indicate heart disease, to cite two examples: The patient with emphysema, who has only a diminished amount of tidal air at his disposal, is dyspneic, while the neurotic patient speaks of shortness of breath, but really refers to the sighing type of respiration.

As a rule, however, dyspnea calls for careful study of the heart. This is particularly true, for instance, with paroxysmal dyspnea associated with wheezing, occurring spontaneously at night time or subsequent to effort such as walking against the cold wind or during sexual intercourse. Such cardiac asthma is often erroneously interpreted and treated as allergic or bacterial asthma. Attacks of pulmonary edema are not always properly recognized, and the medical history of patients with hypertension, arteriosclerosis, and mitral stenosis with sinus rhythm, should be carefully scrutinized with this thought in mind.

In examining the heart proper, too much emphasis is likely to be laid on the presence or absence of murmurs, on blood pressure readings, and on heart size, while not enough attention is paid to certain signs indicative of left ventricular failure, such as Cheyne-Stokes respiration, gallop rhythm, alternation of the pulse, and early pulmonary congestion (as revealed by the roentgen rays). An electrocardiographic tracing (e. c. g.) is indicated whenever there is suspicion that the myocardium is diseased. Hence we should suggest such a study in the presence of the following symptoms, signs and conditions: angina pectoris, dyspnea coming on spontaneously or on effort, cardiac enlargement without valvular lesion accounting for it, hypertension present or past, diabetes, absence of pulsations in the vessels of the legs; and, generally speaking, for patients in the higher age group—particularly if there is a family history of angina pectoris, apoplexy and hypertension.

In this connection two recent surgical statistics, coming from the Scandinavian countries, should be cited. The first is from the City Hospital in Copenhagen. In two groups of 253 and 100 patients, respectively, who were clinically alike as far as the heart is concerned, the postoperative mortality from heart failure was 1.1 per cent in the group presenting normal electrocardiograms and roentgenograms of the heart, and 11.8 per cent in the other group, which showed electrocardiographic and roentgenologic abnormalities. The second study is from the St. Görans Hospital in Stockholm. The cardiovascular postoperative mortality increased fourfold for the thyrotoxic group, and more than doubled for the surgical material—excluding the thyrotoxic—if an abnormal e. c. g. was present. It is



only proper to state that a normal e. c. g. alone cannot guarantee that the heart will stand an operation, nor that the heart is anatomically normal. Furthermore, there is an occasional physician whose experience and training are not wide enough and whose interpretation may be misleading.

The judgment of the functional capacity of the heart is determined in good part by a knowledge of the type of pathology present in the heart. Rheumatic valvular defects, as a rule, are good operative risks, but there are two exceptions. One is represented by high grade mitral stenosis associated with sinus rhythm. Here pulmonary edema is likely to develop. The other one is aortic stenosis of a high degree which favors syncopal attacks. Here sudden death is likely to occur. Participation of the heart in thyrotoxic disease likewise permits an optimistic evaluation, and this is mainly due to the proper preoperative management of such cases. Hypertensive patients stand operations well, provided there is no advanced coronary arteriosclerosis present, and provided a sudden and marked rise or fall in the blood pressure is avoided. The level of the blood pressure alone is not a safe guide. A patient with a pressure of 160/100, with anginal discomfort, is a poorer risk than a patient with a pressure of 200/120, who carries on normal activities of life.

If albumin and casts are found in the urine, the chemistry of the blood and the function of the kidneys should be studied. Patients with nephritis, acute or subacute, or with an acute exacerbation of chronic nephritis, and with a diminished urinary output are poor risks. Postoperative uremia may ensue.

Advanced coronary sclerosis adds to the operative risk particularly, because of the occurrence of cardiac infarction. A history pointing toward cardiac infarction is important, for such patients are candidates for another attack, and surgery of election should be avoided in such instances. Coronary thrombosis occurs mainly in men; in women chiefly if there is present diabetes, hypertension, or both. In this connection, one is reminded of the following story: Billroth was once asked by his assistant whether he should go ahead with a gastrectomy in Billroth's absence. Whereupon Billroth answered: "Yes, it may be performed if the patient is a woman, but not if the patient is a man."

Syphilitic aortitis, particularly in those patients who have anginal discomfort and valvular insufficiency, is a fairly common cause of sudden death; this fact is closely associated with the presence of coronary ostium stenosis, and such patients may die during or shortly after operation. Without coronary ostium involvement, however, such cases may well stand any kind of anesthesia and operation, and this includes instances with large aneurysms.

Disorders of conduction, such as the different types of heart block, are to be evaluated in connection with the status of the myocardium. Disorders of rhythm usually disturb the surgeon more than the patient. Paroxysmal attacks of rapid, regular or irregular heart action, such as auricular tachycardia; fibrillation, flutter, and premature ventricular beats will occur not rarely during or shortly after operation. The latter disturbance is often noted with a distended abdomen. All these conditions are not cardiac emergencies and usually subside spontaneously in a short time. If they persist, they can be readily controlled by medical measures. Permanent auricular fibrillation or flutter on a rheumatic or arteriosclerotic basis, with a rapid ventricular rate, should be controlled by digitalis, while the thyrotoxic etiology is best controlled by the operation itself.

Digitalis often has been, and still is, used improperly in surgical cases. No useful purpose is served by routine preoperative or postoperative administration of digitalis to patients who do not have heart failure or auricular fibrillation. Digitalis is not indicated in operative or postoperative shock or collapse. It is not indicated as a rule in coronary thrombosis. It has no place in combating the ordinary tachycardia, in connection with vascular collapse, blood loss, infection, cerebral trauma. The practice of giving an injection of 2 c.c. of a soluble digitalis body as a stimulant cannot possibly have any effect. Provided digitalis is indicated, and assuming that the patient has not been already receiving digitalis, 6 to 10 times as much should be given, and parenterally by preference.

So far as the choice of anesthetics is concerned, it has been rightly said that the choice of a competent anesthetist is far more important than the choice of the anesthetic. General anesthesia offers the opportunity for psychic detachment, which is desirable at least in those cardiacs who, under the influence of excitement tend to develop cardiac asthma and pulmonary edema. The cardiac strain incidental to the excitement stage of anesthesia with nitrous oxide, ethylene or ether, is avoided in avertin anesthesia. Ether seems to be contraindicated in the presence of pulmonary congestion.

Epinephrine as used in local anesthesia will cause in some people palpitation, oppression, tremor, pallor, considerable increase in the blood pressure, rapid pulse and disturbances of rhythm, including ventricular tachycardia. Patients with thyrotoxicosis are particularly sensitive, but hypertensives, diabetics, and pregnant women, should also be under consideration. And in patients predisposed to attacks of angina pectoris, epinephrine will easily bring them on, and it is, therefore, strictly contraindicated in such cases. Even coronary thrombosis has followed its use in order to enhance tissue anemia. One may successfully use pituitrin, 5 to 10 units for each



250 c.c. of procaine in general surgery; 1 to 3 units for each 30 c.c. for tonsillectomy; and  $\frac{1}{2}$  unit for each 2 c.c. for dental extractions. Pituitrin is heat resistant and can be sterilized. Another vasoconstrictor and hemostatic substance is the recently introduced cobefrin, an isomer of epinephrine; it has a lower toxicity and causes less rise in blood pressure. For vasoconstrictor action in connection with local anesthetics, it is used in concentrations 1:10,000 to 1:80,000.

Spinal anesthesia lowers the blood pressure, mainly due to the abolition of pressor impulses which results in vasomotor paralysis; a minor cause is the diminished respiratory excursion, which is due to abdominal and intercostal muscle paralysis. In cases with hypertension, the fall in the blood pressure levels shows a greater percentage of the initial pressure and the final reading is as low as—or lower—than normal cases. The Trendelenburg position raises the blood pressure. Patients with fixed hypertension of long duration, and with secondary vascular cerebral changes, may respond unfavorably to such a sudden lowering of the blood pressure and multiple cerebral hemorrhages or hemiplegias have been observed to follow. The effect of ascending spinal anesthetics upon the blood pressure could be demonstrated in the following experiment.

The patient, a boy aged 12 with beginning malignant hypertension, was placed on the right side in the Trendelenburg position. A lumbar puncture was done at the third lumbar interspace with an 18-gauge needle. A cysternal puncture was done. To the cysternal needle was attached a glass tube calibrated to 100 c.c. column, but containing only 50 c.c. of normal saline at a temperature between 103 and 105 F. The purpose of this calibrated tube is to modify the fluid level at will in the spinal canal. The stylet was then removed from the needle in the third lumbar interspace, and 1 c.c. of light spinocain was injected into the subarachnoidal space. Since the patient was in the Trendelenburg position, and since the spinocain was lighter than the spinal fluid, it floated on top of the spinal fluid and remained in the caudal region until the cysternal burette was lowered. This permitted the spinal fluid to leave the system in the cysternal region, and gradually to carry with it the cubic centimeter of light spinocain, which in an ascending manner produced an ascending controlled type of spinal anesthesia. When the anesthesia has reached the highest level that the operator desires, the burette with its contents is raised high above the level of the spinal canal, and in a reverse manner the anesthesia descends, so that within a period of 15 to 20 minutes the legs are again moved. (This method was devised by Doctors Fay and Gotten, *Arch. Neurol. Psych.* 30: 1276, 1933.) Before starting the above procedure, the patient had a blood pressure of 195/145. The anesthesia gradually ascended until the level of the fifth thoracic segment was reached, when the pressure dropped to 160/120. When the fourth segment was reached, it remained the same. When the third segment was reached, the reading dropped to 120/80 and stayed there until anesthesia as far as the inside of the hands was reached, which was the eighth cervical segment. The procedure was then reversed, and the anesthesia descended. The blood pressure then rose to 154/130 when the fourth thoracic segment was reached; to 178/136 when the fifth segment was reached, and was back at its original level when the ninth segment was

reached, and remained so to the completion of the experiment when the legs moved again.

The cardiovascular system may participate in postoperative complications in a three-fold fashion: viz., pulmonary embolism, cardiac infarction, and pericarditis. Pain is present in all three of these conditions, but it is correct to state that postoperative chest pain more often is due to other conditions, such as tracheitis, pleurisy, very rapid heart action, etc. Of the three conditions mentioned, pulmonary embolism is the most common one. It often is the cause for a sudden and otherwise unexplainable turn for the worse, particularly in cardiac cases. Its occurrence leads to a rapid downward course and often signalizes the beginning of the end. Distant venous thromboses, particularly in the deep veins of the calf, is the most common antecedent. Not a few patients die suddenly. Those who survive, at least for several hours, commonly reveal a picture of dyspnea, substernal oppression, vasomotor shock, and slight cyanosis. The traditional findings of hemoptyses and pleural pain may be absent altogether. This syndrome is called acute pulmonary heart disease. In many aspects it resembles cardiac infarction, but it has its rather characteristic electrocardiographic features. These features appear very soon after the onset of the condition and may disappear very rapidly. In order to be of the greatest diagnostic value, the electrocardiographic study should be begun within the first hour or two after the onset of symptoms. Finally, there is a group of patients who, in the postoperative period, have smothering attacks, feel very tired, show some apparently unexplainable rise in temperature and pulse rate, and reveal a leukocytosis. They also are likely to have had small infarcts. Sometimes a pulmonary infarct is diagnosed only in retrospect because of the development of an icterus. Around areas of pulmonary infarcts, pneumonic consolidation may develop. Pneumonias around areas of atelectasis and infarcts are the most common types of postoperative pneumonias.

Prevention of pulmonary embolism is perhaps enhanced by those procedures which will speed up the venous blood flow. Limitation of the postoperative immobilization to a minimum time is desirable; massage and strychnine may be useful, because they increase the muscle tone and hence favor venous return. In the treatment of the attack itself, the administration intravenously of eupaverine or papaverine in doses of  $\frac{1}{2}$  to 1 grain, and repeated several times, is the most valuable remedy that can be suggested at present.

Coronary thrombosis, leading to myocardial infarction, is not so rare a postoperative complication. Five per cent of the total number of coronary thrombosis attacks cared for during an eight-

year period at the Mt. Sinai Hospital in New York City, followed operations. The great majority of cases with cardiac infarction reveal characteristic electrocardiographic tracings, though several studies at short intervals may be needed before the diagnosis is established. Mural thrombi may then become the source of peripheral emboli. Finally, pericarditis follows operation occasionally. Here also the electrocardiogram may reveal characteristic features. We have, then, cited three conditions which are responsible for postoperative chest pain, in all of which the e. c. g. study may offer invaluable diagnostic help.

A medical discussion of surgery of the heart and blood vessels should be of interest, because in the majority of instances it is a medical advisor who will vote for or against such operations. A discussion of surgical technic can be readily dispensed with in this presentation. Neither is a complete survey intended. First of all, I wish to state that total thyroidectomy for heart failure has been rather disappointing. I like to predict that those surgical procedures devised for the reduction of hypertension will likewise soon be chiefly of historical interest. Those who claim good results seem to forget that hypertensive cases show spontaneous remissions in their course; the figures offered as proof of success are unimpressive, and follow-up studies refer to an insufficient period of time, and—last, but not least—we can point out that the medical treatment with sulphocyanates, properly controlled, gives fairly satisfactory results in about one-half of all cases, and that includes even an occasional case of so-called malignant hypertension. Concerning the grafting of pectoral muscle and of omentum upon the heart, further follow-up results should be awaited before accepting this procedure. We believe that here too the initial enthusiasm will be rewarded by disappointment.

Surgery is a method of choice in the following conditions:

1. The abnormal side-to-side arteriovenous communication, usually traumatic in nature. Cardiac enlargement and failure will result if this fistula is large enough, and return to the normal takes place subsequent to the closure of the fistula.
2. If the heart has suffered damage from a prolonged thyrotoxic state, improvement will result from the subtotal removal of the thyroid gland. It is well to point out at this occasion that cardiac enlargement, cardiac failure, and perhaps also auricular fibrillation result from the effect of the elevated metabolism on a heart that is presumably already damaged by other factors; and furthermore, that reduction in the size of the heart may take place even during the period of proper preoperative preparation.
3. Embolectomy should be mentioned. It should be considered particularly in those cases where for anatomic reasons alone a sufficient collateral circulation is not likely to be available or where generalized vascular damage probably would prevent the establishment of such a collateral circulation. Before

embolectomy is attempted, however, antispasmodic treatment should be tried. We refer to the use of eupaverine and papaverine, preferably given intra-arterially.

4. Interruption of nervous pathways for intractable pain arising from the cardiovascular system is a definitely established surgical procedure. Such operations require a skillful neurosurgeon. The afferent sensory impulses may be reliably interrupted by two procedures. One consists in the section of the first to the fifth posterior thoracic roots, following laminectomy. This, in my opinion, is the most logical approach. The other refers to the paravertebral nerve block by injecting alcohol in the region of the upper five dorsal rami communicantes near the sympathetic ganglia. Irritation of the pleura, severe and persistent neuritis are complications. Eliminating the first thoracic ganglion causes a Horner complex.

5. This is the most important procedure and refers to pericardiectomy in the course of adhesive-constrictive pericardial disease. The classical clinical picture should not be missed any more. The size of the heart is normal, and so are the sounds, although occasionally a reduplicated second apical sound is noted. The apical thrust is usually not felt. The precordium may reveal a forceful diastolic propulsion, which is followed by a systolic depression. Auricular fibrillation may occur. The blood pressure is rather low. Venous stasis is present with ascites, and over-filling of the neck veins is in the foreground. The engorged liver reveals a diastolic collapse followed by a less conspicuous systolic elevation. The preoperative management consists in the relief of the edema, if possible; digitalization is indicated in the presence of auricular fibrillation. Those anesthetics which depress the respiratory center should be avoided. A tracheal tube is an essential part of the operative procedure, anticipating pneumothorax when working in this area.

The third part of our presentation deals with differential diagnosis between medical problems and acute surgical conditions of which some are cardiovascular disorders. Postoperative collapse is usually due to dehydration, hemorrhage or infection; but occasionally is caused by pulmonary embolism or cardiac infarction. Jaundice is noted in connection with congestive failure and also subsequent to a pulmonary infarction; a damaged liver appears to be a necessary prerequisite. Edema need not be cardiac in origin, and it is well to remember that obesity, varicosity, and venous thrombosis in the past are common causes of ankle edema. Generalized, dependent edema is noted in patients who lose a great amount of protein. This, among other conditions, is observed in surgical cases with prolonged open drainage, especially when nutrition previously has been poor. The lowering of the blood protein, with particular reference to the albumin, causes a drop in the osmotic pressure. This, plus the presence of sodium in the intracellular tissue, favors the collection of fluid. Treatment should consist in a high protein, salt-free diet, and repeated transfusions of whole blood; plasma alone should be given where hemoconcentration is undesirable because of the added strain on the circulation.



Arterial embolism or thrombosis in the extremities may be erroneously diagnosed where the real condition is arterial spasm subsequent to sudden, massive venous thrombosis. We are dealing here with thrombosis which exclusively affects the deep femoro-iliac veins and often will reveal the common signs, i. e., normal skin temperature, edema, distended veins, the whole leg and thigh being affected, and tenderness follows the femoral vessels. An arterial reaction must be assumed for a good many cases, since the femoral pulse is slightly weaker on the affected side, and this is observed prior to the onset of swelling and objectively shown by the study of the oscillometric amplitudes. Other cases with a sudden onset of a massive thrombosis give an alarming picture, imitating sudden arterial occlusion. There are actual signs and symptoms of markedly diminished arterial blood supply, such as pallor and mottled cyanosis, pain, lowering of skin temperature, numbness, lack of reflexes, and muscular weakness; the arterial pulsations are palpated very slightly or not at all, and the oscillometric amplitude is much diminished. A number of instances are known where the operation showed the femoral artery in maximal spastic contraction but free from an embolus. In differential diagnosis one must consider the mode of onset and the known possibilities of embolism. Puerperal sepsis or a recent laparotomy speak in favor of venous thrombosis. Disease of the aortic or mitral valves and thrombosis on the walls of the heart, particularly if associated with auricular fibrillation, speak in favor of arterial embolism; obstructive atherosclerosis or thrombo-angiitis, in favor of arterial thrombosis. Arterial spasm, due to massive venous thrombosis, usually disappears in a few hours and venous swelling makes its appearance. If one is in doubt, such a case should be handled like an arterial embolism, i. e., repeated intravenous or intraarterial injections of  $\frac{1}{2}$  to 1 grain of eupaverine or papaverine, morphine hypodermically, and whiskey; if no improvement is shown in a few hours, surgery is indicated.

The presence of abnormal chest wall movements, consisting of pulsatory depressions or propulsions of the chest wall, has led physicians to diagnose adhesive-constrictive pericardial disease, but on subsequent operation no evidence of pericardial disease was found; instead the condition found was usually an enlarged heart. Such abnormal movements of the chest wall, requiring a careful analysis for a given case, are noted in a number of different conditions, such as ventricular aneurysm, advanced mitral stenosis, mitral regurgitation with aneurysmal enlargement of the left atrium, free aortic regurgitation and, most important, tricuspid regurgitation. The latter condition is most likely to imitate adhesive pericardial disease. A careful analysis of the liver pulse usually offers a clue to the differential diagnosis.

There are four types of cardiovascular conditions which may resemble an acute surgical condition of the abdomen.

1. Emboli to the kidneys, spleen and mesenteric arteries offer difficult diagnostic problems; thought should be given to such a possibility if evidence points towards abnormalities in the heart that are conducive to arterial emboli, such as bacterial endocarditis, mitral stenosis, auricular fibrillation and infarction of the ventricle from coronary thrombosis.

2. Acute or subacute swelling of the liver, due to heart disease, may resemble acute cholecystitis. This may happen to a cardiac patient whose heart fails because of severe physical overexertion or because of an attack of rapid (regular or irregular) heart action. Nausea and vomiting likewise accompany congestion. However, fever and leukocytosis are usually lacking or mild. Patients with advanced coronary artery disease and the anginal syndrome often suffer from digestive troubles, have distention, belching and pain after meal intake.

3. The acute pain of coronary thrombosis may be localized in the epigastrium and behind the lower sternum; nausea and vomiting is common. It should be remembered that morphine given for the relief of pain may have induced it. Slight fever and leukocytosis complicate the feature. Physical examination of the heart may be normal altogether. Surgical conditions under consideration are then perforated peptic ulcer, gall stone colic or acute cholecystitis, acute pancreatitis. Of course the combination of angina pectoris and cholelithiasis is not at all rare. An electrocardiographic study should be undertaken immediately. The first tracing may well be inconclusive, and occasionally an unnecessary exploratory laparotomy will have to be performed in order to avoid the hazardous attitude of watchful waiting.

4. Finally, it must be emphasized that abdominal pain in children and adolescents may be a manifestation of rheumatic fever. The history of slight aches in the limbs, an inconspicuous joint swelling, lack of appetite, epistaxis, nervousness masking chorea may all have been overlooked. Similarly, the presence of tachycardia, of gallop rhythm—indicating myocarditis, of a systolic murmur, of cardiac hyperactivity may not be properly evaluated. Pain, fever, localized tenderness, leukocytosis, taken all together may lead to the diagnosis of appendicitis and to an unnecessary operation. The finding of a normal appendix and the lack of improvement in the clinical picture clinch the diagnosis completely.

It would seem from this presentation that the cardiovascular system plays a considerable role in the wide field of surgery. This is of course not so. The heart is a wonderful organ. But when things go wrong the surgeon is sometimes too apt to blame the heart. Instead every other possible complication should be first looked for. Certainly, as a writer has stated it, in order to be legitimately dead, the heart must stop. But the patient does not die because of his heart unless he dies from cardiac syncope or from congestive heart failure.

## INFECTIONS OF THE HAND

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**F**OR several years I have been impressed with the fact that the so-called minor surgical conditions and operations have received scant attention at our surgical meetings. The papers on series of successful gastroenterostomies and cholecystectomies have far outnumbered the papers on the lowly operation for ingrown toenail or proper incisions for infections of the hand. Major surgery is in the saddle and so-called minor surgery lags behind. The same indictment, I fear, may be charged against present day medical schools in regard to the teaching of surgery. The glamor of doing a gastroenterostomy far outshines the proper suturing of a tendon or the neat application of a bandage. And yet these latter procedures are most important for the recent graduate in medicine.

Some time ago a young doctor who had been out of college a year consulted me in regard to a paronychia. He had suffered with it for several weeks, with no improvement, in spite of salves and other applications. I told him that the base of the nail should be removed and until that was done no cure would result. I removed the nail. After the operation, he stated to me that just a week before a patient had come to his office with the same condition. He was embarrassed. He did not know how to treat the paronychia because he had never seen it before nor had he ever seen the operation done.

I feel, therefore, I need make no apology for speaking on hand infections and pointing out some of the mistakes we have made and are still making in the management of these infections. I believe it is an important topic because, if the initial treatment is maldirected or the initial incision improperly or inadequately done, the infection spreads and the so-called frozen hand which results will forever remain as a mocking witness of our negligent or ignorant surgery. Again the patient with a spreading infection of the hand may end up with an amputation of the arm or, still worse, death may end the sufferings of a patient who may have had the infection for a number of weeks and who finally succumbs to a blood stream infection.

In order intelligently to incise any infection in the fingers or palm, it is necessary to review briefly the anatomy of the hand. At the

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The author and the Editors wish to express their thanks to the authors and publishers who have so kindly given their permission to reproduce the illustrations used in this paper.

palmar aspect of the distal phalanges are terminal closed spaces which are made up of fat caverns which run anteroposteriorly from the periosteum of the phalanx to the skin. This terminal closed space extends from the tip of the finger to a point about  $\frac{1}{4}$  inch distal to the distal crease of the finger and is completely walled off by an envelope of fascial tissue not only from the flexor profundus tendons but also from the epiphyseal end of the bone.<sup>1</sup> It is known also that the diaphysis of the bone is supplied by the digital arteries after they enter the space. The epiphysis is supplied by the arteries before entering the space. This anatomic fact explains the reason of necrosis of the distal end of the bone in untreated closed space infections.

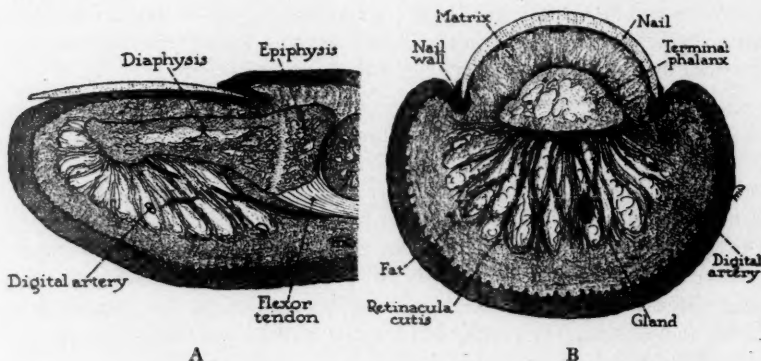


Fig. 1. A. Longitudinal section of terminal phalanx of finger, semidiagrammatic. Anterior closed space, in which felon develops, corresponds to the portion of the pad which overlies the diaphysis of bone. The epiphysis and termination of the flexor tendon lie outside this space. Small branches of the digital artery supplying the diaphysis pass through dense confines of the space and are quickly compressed by an inflammatory swelling.

B. Cross section of the terminal phalanx of the finger, semidiagrammatic. Dense fibrous columns (retinacula cutis) pass from the lower layer of the skin to attach to the periosteum. Between these columns of fatty tissue containing sweat glands, nerve fibers and blood vessels. To obtain adequate drainage of the felon, it is necessary to divide these fibrous columns.

Both plates from Kanavel, A. B., and Mason, M. L.: *Hand Infections*, *Cyclopedia of Medicine*, vol. vi, 1932. Courtesy of F. A. Davis Company, Philadelphia.

The nail is a modified skin structure which rests on an extremely vascular bed. The subjacent epithelium is the nail matrix. It is between the nail and the adjacent skin that infection enters and at first sets up localized infection and later a paronychia.

Each tendon of the finger is covered with a tendon sheath into which infection may localize or travel up the hand and under the annular ligament up into the forearm. It is important to remember in the arrangement of the tendon sheaths, that the sheath of the thumb (flexor pollicis) connects directly with the radial bursa; like-



wise that the tendon sheath of the small finger (*flexor minimi digiti*) connects with the ulnar bursa. These bursae transmit infection under the annular ligament up into the forearm. Hence we may state as a general rule that infections of the thumb and small finger are potentially more serious than infections of the other three phalanges. At the base of these three fingers, there is a definite fascial membrane which would tend to localize the infection in the middle fingers.

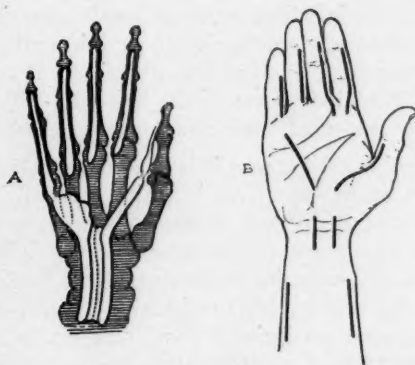


Fig. 2. A. The flexor tendon sheaths of the fingers and hands. After Kanavel.

B. Situation of incisions for draining the various sheaths.

From Homans' Textbook of Surgery, 4th Edition. Courtesy of Charles C Thomas, Publisher, Springfield, Illinois.

Infection of the ulnar side of thumb and index finger would in all probability tend to spread to the thenar space.

Infection of the middle and ring fingers and radial side of the little finger would tend to spread to the mid-palmar space.

There are five anatomic spaces in the hand, only two of which are important from a surgical standpoint: the mid-palmar space and the thenar space. The mid-palmar space occupies approximately the middle third of the palm and stands ready to receive infection from the middle, ring finger, and radial side of the small finger. The thenar space occupies approximately the radial third of the palm and stands ready to receive infection from the index finger and the ulnar side of the thumb. The radial side of the thumb drains into the radial bursa, the ulnar side of the little finger drains into the ulnar bursa.

These anatomic considerations are important, I think, because if we keep them in mind we will be able to trace an infection from the fingers to the palm.

When a patient presents himself to us for treatment of an infection of the hand, there are two things to keep in mind: First, we must cure the infection; second, we must re-establish function of the part. In many instances the control of infection and the restoration of function are easy enough because in simple infections which are controlled function follows rapidly. However, in other instances in which the infection may be prolonged, we lose sight of the function of the part and the patient recovers with a stiff, useless hand. I do not advocate, of course, any active or passive motion during the acute stage of the infection or while localization is taking place, but I do believe that movement should be initiated as soon as the infection is localized and the incision draining. It should not wait until the wound is healed. Cure of the infection will be scant satisfaction to us if a deformed, claw hand results.

When an infection is first seen it is absolutely necessary to decide whether it is an acute spreading infection (cellulitis or lymphangitis) or a localized collection of pus (felon or tenosynovitis) and then to institute appropriate treatment at once. These two conditions demand exactly opposite treatments. In the case of localized infections immediate and adequate incision should be made, while in the spreading ones no incision should be made. A cellulitis or lymphangitis should be a *nolle me tangere*—a “no man’s land”—so far as the scalpel is concerned. The prompt institution of conservative treatment gives the patient his best and perhaps his only chance of living. As Mason<sup>2</sup> has said,

Any one of us could cite examples of serious or fatal infections which have followed the injudicious incision of a throbbing, painful finger; incisions which have yielded no pus and which were followed by a chill, rapid rise in temperature, increase in toxemia and rapid extension of the process by way of the lymphatics and cellular tissues. The temptation to incise, often at the insistence of the patient, is frequently too great for us to resist. The desire to do something and the unwillingness to assume a “masterful inactivity” have cost many patients a hand or a life.

The patient with an acute spreading infection should be hospitalized, with absolute rest in bed and massive wet packs of boric acid solution or normal saline to the entire arm. These should be kept warm with electric lights. Large amounts of fluid should be given the patient. This treatment of rest and watchful waiting should be continued until all evidence of extension has disappeared and definite localization of pus has taken place. This may not occur for ten days or two weeks but until there is a definite localized suppuration, no incision should be made.

The etiologic factors concerned in hand infections are beyond the surgeon’s control, except by the education of the laity and industrial workers in regard to dangers of neglect and self treatment. Punc-

tured wounds by needles and pins, accidental injuries by knives and scissors already contaminated with virulent germs are acclimated to growth in human tissue, meddling with blisters, unprotected blisters and abrasions, squeezing of infections, removal of splinters by laymen, all of these are factors in not only causing infections, but aggravating them. It is interesting to note that many infections occur in physicians and nurses in the course of their professional duties. It must be admitted also that surgeons who are particularly interested in major surgery pay scant attention to trivial injuries of the hand which may later develop into a serious infection.

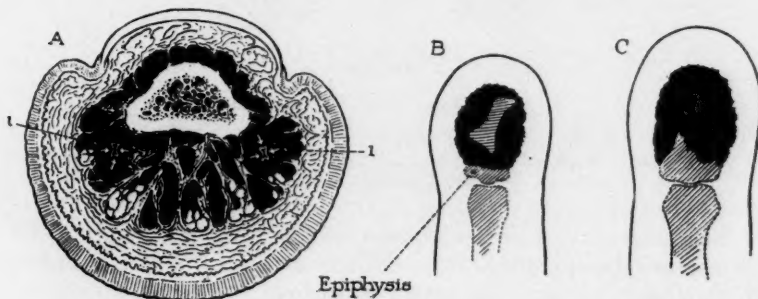


Fig. 3. A. Cross section of terminal phalanx to show how the arteries are compressed by pus within the closed space. From Kanavel, A. B., and Mason, M. L., *Hand Infections*, *Cyclopedia of Medicine*, vol. vi, 1932. Courtesy F. A. Davis Company.

Fig. 3. B. Detachment of the diaphysis in a child.

Fig. 3. C. Necrosis of the diaphysis in an adult.

From Homans' *Textbook of Surgery*, 4th Edition. Courtesy of Charles C Thomas, Publisher, Springfield, Illinois.

The use of a local anesthetic in incisions of the fingers or palm is not only unsatisfactory but dangerous. Its use is painful to the patient, may actually spread the infection, and also will probably cause a devitalization of the tissues in the neighborhood of the infection. It is seldom that one obtains a satisfactory analgesia; hence, in many cases, a secondary incision must be done, with a more serious infection to treat. The injection of novocain or other analgesic at the base of the finger is open to objection also, in that such an injection devitalizes tissue and we are uncertain whether or not infection is present at this location. The use of ethyl chloride has never been satisfactory in my hands. It has never rendered the infected area painless and obviously, on account of its freezing quality, there is great danger of devitalization of the tissue. It is mentioned only to be condemned. It seems therefore that analgesia

should be eliminated in the surgery of hand infections. A general anesthetic (preferably nitrous oxide) will insure a smoother operation and an exact and adequate incision.

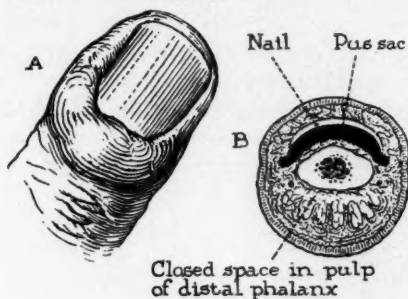


Fig. 4. A. Appearance of a paronychia.

Fig. 4. B. Cross section of a paronychia showing elevation of the root of the nail.

From Homans' Textbook of Surgery, 4th Edition. Courtesy of Charles C Thomas, Publisher, Springfield, Illinois.

Soap and water I believe to be the best cleansing agent for the skin before the operation. This not only cleanses the skin, but effectively removes any desquamated epithelium or wound secretions. The use of tincture of iodine, bichloride of mercury or other strong antiseptic, is condemned because these agents devitalize tissue already weakened from the infection. Iodine should not be employed, particularly when we expect to use warm applications afterwards.

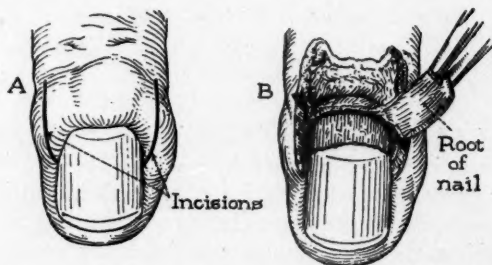


Fig. 5. A and B. Operation for fully developed paronychia.

From Homans' Textbook of Surgery, 4th Edition. Courtesy of Charles C Thomas, Publisher, Springfield, Illinois.

As a general rule, incisions should not be made transversely to the creases in the finger or palm. In cases of suppurative tenosynovitis, the incision should be along the lateral border of the finger and not in the midline. An incision on the palmar surface of the finger frequently causes a herniation of the tendon which will be

impossible to replace, a superabundance of granulation tissue, production of fibrous tissue with webbing and a marked flexion deformity of the finger.

The incision for the proper drainage of an infection in the anterior closed space is a transverse one, extending from beyond the distal crease of the finger around the front to a corresponding point on the opposite side. This is the fish-mouth or horseshoe incision and amply drains both ends of the divided fascial spaces. One may readily appreciate the futility of a longitudinal incision over the

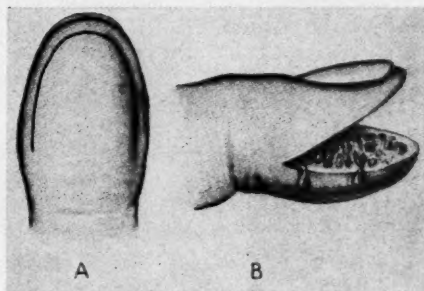


Fig. 6. Fish mouth or horseshoe incision.

From Kanavel, A. B., and Mason, M. L.: *Hand Infections*, *Cyclopedia of Medicine*, vol. vi, 1932. F. A. Davis Company, Philadelphia.

middle of the closed space: it does not adequately drain the space, but deforms the finger and disturbs the tactile sense. The transverse incision provides the necessary drainage, produces practically no deformity, does not interrupt the sense of touch and is based on the anatomy of the part. Kanavel, however, favors the hockey stick incision, claiming that such an incision is sufficient for drainage and does not produce any tactile impairment.

The incision for abscess of the mid-palmar space should be a longitudinal incision between the middle and ring fingers, extending from the web to the distal crease of the palm. The incision is carried through the skin, forceps introduced in an oblique downward direction under the tendons, blades opened and pus evacuated.

The incision for abscess of the thenar space is made to the radial side of the index metacarpal on the dorsum of the hand, forceps introduced and pus evacuated.

Drainage is unimportant in infections of the hand, provided we have made the incision at the right place and of adequate size. The use of dry gauze and unyielding rubber have no place in these cases.



Dry gauze corks up the infection and hard rubber tubing produces a necrosis of the tissue. It is undoubtedly true that prolonged drainage continues the discharge. The only drainage material that is rational, it seems to me, is vaselized gauze or a thin piece of rubber tissue. Moreover, this material should be removed after 48 hours, otherwise it will prolong suppuration. The drainage material acts as a foreign body and drainage will continue as long as it is left in the wound. "It promotes drainage, of course, but in the same way that any foreign body such as a piece of dead bone, or necrotic tendon promotes drainage until it is removed." The long continued use of a drain also favors secondary infection and continuous reinfection of the wound.



Fig. 7. A collar button abscess of the palm. Pus has penetrated through the web to the back of the hand.

From Homans' Textbook of Surgery, 4th Edition. Courtesy of Charles C Thomas, Publisher, Springfield, Illinois.

During the dressing of infected wounds of the hand, we should observe the same scrupulous asepsis we observe in clean surgical wounds. There is no reason to believe that because a wound is infected further contamination by unsurgical or slovenly methods will do no harm. A mildly infected wound can most assuredly be made more serious by secondary infection at time of dressing. How often do we see surgeons violating the simple rules of asepsis! How often do we see the surgeon wash his hands after the dressing rather than before! How often do we see gauze replaced on a wound after it has fallen on the bed! I fear we surgeons assume a more or less fatalistic attitude in these infected hands and feel that the infection is already there so why worry. I am convinced that not only should the entire drapes and instruments for handling dressings be sterile but that sterile rubber gloves should be worn also. When suppu-

tion is long continued, it might be well to consider the possibility of continued secondary infections before we blame other causes.

"Because a wound heals in spite of our lack of asepsis, speaks in favor of the natural resistance of the tissues and not in favor of our careless methods," says Mason.

To quote Kanavel, "Rest is one of the essential factors in the treatment of infections of the hand. The extremity affected should always be so fixed that movement either of the whole or muscular action of a part is impossible since it is well known that lymphatic streams are aided materially in their return flow by muscular action." We are accustomed to think of splinting in fractures but rest, splinting and immobilization are just as important in hand infections. "If one had to choose one therapeutic agent from many at our disposal, that agent would be rest." (Mason) And yet how rarely do we consider splinting the hand after incision of a palmar abscess and how even less seldom in a minor infection.

Human bites and lacerations produced by impact of the closed fist against the teeth of another in a fight cause an exceedingly virulent infection, on account of the type of wound, the organisms introduced and the anatomy of the part. The most usual site of the injury is at the metacarpophalangeal joint of the middle or index finger and is characterized by marked swelling and a foul odor. These infections not only cause a great loss of time to the individual, but often cause loss of function in parts of the hand, amputations of digits and extremities and occasionally death. Bates<sup>5</sup> states that electrocauterization offers the best treatment used even as late as the third day. In 122 cases treated, 97 per cent resulted favorably.

Kanavel in his outstanding monograph on hand infections stresses the importance of maintaining the hand in the position of function. This position briefly consists of a dorsiflexion at the wrist, with abduction and flexion of all the fingers and flexion of the thumb with abduction towards the fingers.

In this paper, I have endeavored to point out:

1. The need for more papers concerned with so-called minor surgery.
2. Importance of the initial treatment of infections of the hand.
3. Brief anatomy of the hand.
4. The dos and don'ts of the management of these infections.

In conclusion, let me say that hand infections still are responsible for from 5 to 9 per cent of all total disabilities and of the total hand

disabilities, even as high as 50 per cent arise from infections—a large proportion of these having their inception in trivial injuries.<sup>9</sup>

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## CINE-FLUOROGRAPHY

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**C**INE-FLUOROGRAPHY is the name we have given to this new method of examination. It is essentially a moving picture of the fluoroscopic image and bears the same relation to ordinary x-ray examination that moving pictures bear to still photography. It must be remembered, however, that roentgenographic examination is not photography. An x-ray film is not a picture but a study in density recorded on photographic film or seen on a fluoroscopic screen.

As you all know, x-ray radiation is produced by bombardment of a tungsten target by electrons drawn from a heated filament in a vacuum by a high tension direct current. The higher the voltage across the tube, the faster the movement of the electrons and consequently the more penetrating the x-ray beam produced. The kilovoltage is therefore an index of the penetration of the x-ray beam.

The other fundamental factor involved in the production of x-rays is the milliamperage. The hotter the filament the more electrons expelled and the greater the amount of x-ray produced.

The production of satisfactory roentgenograms (which are, as we have previously stated, studies in density) depends on registering the difference in the penetrability of different structures. If difference in density is great, as in the case of bones as shown against soft tissues, it is easy with almost any kind of an x-ray to obtain a satisfactory demonstration. Where differences in density are not marked, however, very careful adjustment of kilovoltage and milliamperage are necessary to show successfully any clear definition. Bones, joints, thoracic structures such as the lungs, heart and diaphragm, as well as foreign bodies and calcific deposits are easily shown by ordinary x-ray procedures. Soft tissue masses such as the liver, muscles and fat, spleen and kidneys sometimes can be seen as faintly outlined masses. With the use of contrast substances of high density the usefulness of the x-ray examination has been greatly extended. A barium suspension taken by mouth makes possible investigation of the entire length of the gastrointestinal tract. Diseases of the esophagus, stomach and small intestine may now be diagnosed with a high degree of accuracy. Examination following a barium enema gives similar information concerning the large bowel. Even more remarkable are the iodine preparations which are used to outline the gall-bladder and kidneys, substances which are excreted specifically by different organs and permit their visualization.

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Presented before the Postgraduate Surgical Assembly, the tenth annual meeting, of The Southeastern Surgical Congress, Atlanta, March 6, 7 and 8, 1939.

This, then, is an outline of the background of the subject of cine-fluorography.

As the name indicates, cine-fluorography is the making of a motion picture record of the image on the fluoroscopic screen. Attempts to accomplish this purpose were begun by McIntyre<sup>1</sup> in Glasgow soon after the discovery of the roentgen ray. These efforts met with little success, however, when applied to the living patient. In this country, the late Dr. Eugene W. Caldwell conducted a series of such experiments beginning about 1906 and continuing for about fifteen years without any published success. Gastric motor phenomena were demonstrated more than twenty-five years ago by a motion picture film made from serial radiographs. In 1909 Kaestle, Rieder and Rosenthal<sup>2</sup> made thirteen successive radiographs of the stomach in twenty-two seconds. These were reproduced on a motion picture film, which, when projected, showed the passage of a peristaltic wave toward the pylorus. In 1910 Cole<sup>3</sup> demonstrated a method of making serial roentgenographs on a machine of his own design which employed a continuous x-ray film eight inches wide; he exposed areas of this film at regular intervals. Then, by a process of reduction and selection, combined with animation he was able to manufacture a film as a cinematogram. From 1921 to 1925 Reynolds<sup>4,5</sup> of London made extensive experiments leading at last to a successful motion picture of the fluoroscopic image of a thorax and various joints of the human body. More recently, Reynolds in England, Belot in Paris and Janker in Germany, employing greatly improved apparatus have successively made motion pictures of the fluoroscopic screen.

#### REQUIREMENTS OF THE PROBLEM

The recording of a motion picture film of the movements of organs and joints of the living human being is attended with considerable physical and mechanical difficulty. Any method which can be regarded as a solution of the problem must provide a technic which is safe, simple, convenient and inexpensive. Two methods may be suggested, namely the direct and the indirect.

The direct method is the repeated exposure of any part of the human body to the x-ray beam recorded on a moving continuous x-ray film, as in the usual technic of making separate simple roentgenograms. This method is beset with many difficulties, is expensive and impracticable for routine examinations.

The indirect method makes a motion picture record of the fluoroscopic image. This method is obviously simpler, more accurate and less expensive.

## DIFFICULTIES AND LIMITATIONS

Aside from the inherent mechanical difficulties this method is restricted by definite physical limitations. In solving the problem, which, after all, is that of focusing the greatest amount of light on the most highly sensitive photographic film, the following factors govern the result:

1. The amount of energy in the incident x-ray beam. This is limited by the capacity of the x-ray tube and by the tolerance of the patient's skin.
2. The light producing power of the fluoroscopic screen. This varies qualitatively and quantitatively according to:
  - (a) The chemical composition of the screen.
  - (b) The color of the fluorescence produced by the screen.
3. The light-gathering power of the camera lens system.
4. The photographic sensitivity of the film as related to the fluorescence of the screen.

As the limits of each of the above factors are widened, the greater is the scope of the method and the greater the chance of success.

**X-ray Tube:** The x-ray tube we have found most satisfactory for this purpose is the G. E. 10 R. W. This tube can be safely operated at 100 KV with a current of 110 milliamperes for ten seconds.

**Skin Tolerance:** When this tube is operated at 100 kilovolts, 110 milliamperes at 40 cm. target-skin distance, with 1 mm. of aluminum and 5 mm. of wood filter, the estimated dose of radiation reaching the patient's skin is 500 R per minute. This would be sufficient to produce an erythema in 48 seconds. The average time for each simple exposure has been five seconds which may be repeated two or three times in each case. There is a rest period for the tube of 20 seconds between each five second exposure. This is well within the limits of safety. It is, therefore apparent that the capacity of the x-ray tube is much more a limiting factor than is the tolerance of the patient's skin.

**Lens System:** The lens employed is a Zeiss R-Biotar with an aperture of 0.85 and a focal length of 5.5 cm. In order to cover the fluoroscopic field of 30 by 50 cm. it is necessary to place the lens at a distance of seven feet from the screen. This lens is fitted with a focusing mount and used wide open, no diaphragm being employed.

**Camera:** The Bell and Howell Filmo 70-D, 16 mm. camera fitted with a special finder has been found to be most satisfactory.

**Fluoroscopic Screen and Photographic Film:** The brilliance of the fluoroscopic image varies with the chemical composition of the screen while the photographic results depend upon the sensitivity of the film to that particular wave-length of light emitted by the

screen. After many experiments made with all types of available screens we have found that the most desirable is one developed by Dr. Leonard Levy and Mr. Donald West of London. It is made from a preparation of zinc sulphide and emits a yellow-green fluorescence. It compares favorably with a type B Patterson made in this country. Used in conjunction with the new 16 mm. gray base ultra speed fine grain superpan negative film recently brought out by Agfa Ansco Corporation of Binghamton, N. Y., most satisfactory results have been obtained. With this new photographic product we are able to obtain excellent films of almost any portion of the body. It is conceded however that our results have been much more satisfactory above than below the diaphragm.

**Technic:** Employing the above mentioned factors and the normal camera speed of 16 frames per second, 80 pictures can be obtained in the exposure time of five seconds. This is sufficient to record the motions of such rapidly moving organs as the heart, lungs, and diaphragm as well as to demonstrate the mechanism of swallowing. Films made of the esophagus require at least 12 frames to the second or a total of 60 frames to each exposure. If the camera speed is reduced to 8 frames per second the exposure time per picture is doubled and the apparent motion of the organ is proportionately increased to twice the normal speed.

In suitably thin patients the camera speed may be increased to 24 pictures per second so that when the film is projected the apparent motion is slowed down proportionately and permits more careful study and analysis of the film. Within narrow limits the speed of the apparent motion may be further diminished by reducing the rate of projection. Beyond this point, however, further slowing of the projection speed produces a flickering image.

The following interesting question is often asked, "How do we prevent the film in the camera from fogging?" This is avoided by placing a sheet of heavy glass containing 30 per cent lead directly in front of the fluoroscopic screen. This prevents most of the direct rays from reaching the film through the lens. To provide further protection from scattered radiation we cover the camera with sheet lead.

With the equipment and technic described above we have been able to obtain excellent films in health and disease of the esophagus, stomach, duodenum and gallbladder, although the phase of gastric activity revealed by the film is so short that only a little of the real physiologic activity of the stomach or duodenum can be demonstrated.

The entire action is contained on a strip of film 40 to 60 frames, the projection of which would provide visible action for only a few

seconds. By repeatedly printing this short run on a roll of film twenty-five to fifty feet in length the cycles of action may be projected over and over again for many minutes. This provides ample time of study of the physiologic action of the organs under investigation.

Having obtained a good film it is necessary to use a projectoscope which will give the maximum amount of light and one in which the speed of the shutter can be cut down to a minimum without flickering of the image. A Bell & Howell 1000 watt machine has proven to be most satisfactory.

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## BURSITIS ABOUT THE SHOULDER

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**S**UBDELTOID and subacromial bursitis are names applied to a condition characterized by pain in the region of the shoulder joint of varying intensity, limitation of motion, particularly that of abduction and rotation, together with x-ray findings of a shadow of calcium density in the region of the joint. These complaints and symptoms have for many years been grounds for diagnoses of neuritis, neuralgia, arthritis, rheumatism, fracture and malingering. It has only been through the efforts of comparatively recent workers and the use of the x-ray that a more accurate description of this condition has been possible.

Duplay, working in Paris, is credited with the first description of bursitis in 1872, but it was not until 1896 that his paper received notice or widespread attention. With the discovery of x-ray in 1895, the chief advances in our knowledge of the subject were forthcoming. Küster in 1902 published the first rational description of subacromial bursitis, but did not mention x-ray findings. The names of Codman, Bricker, Carnett and Stieda are prominent in bibliographies on the subject and it is through their work that our present conception of this condition was born.

The average anatomy text dismisses the subject of bursae about the shoulder with a very brief, non-detailed and inaccurate description. A search through various texts, both academic and clinical, reveals the rather startling discovery that a total of thirteen bursae are described as being related to this interesting and important joint. We will dismiss, without naming, ten of this number. The remaining three, which are considered the most important from a clinical viewpoint and which have a place in this paper, are: the subacromial, the subdeltoid and the bursa of the coracobrachialis muscle. We would further simplify the subject by concurring with the workers who refuse to describe these as separate structures and claim that they are all one and the same. Therefore, we will deal with only one structure and call it the subacromial bursa.

This bursa is the largest in the body and the most complicated in structure and in its component parts. It is, in fact and function, a second scapulohumeral joint, although no part is surfaced with cartilage. Instead of being between bone and skin, the common conception of bursae, it is between bone and muscle, bone and tendon. It is firmly attached on its base to the upper and outer three-fourths inch of the greater tuberosity of the humerus, as well as to about a

three-fourths inch of the tendons of the four short rotators attached to the tuberosities. There are: the supraspinatus, infraspinatus, teres minor and the subscapularis. Part of its base also covers the bicipital groove. Its roof is firmly attached to the under side of the acromion process of the scapula and the coraco-acromial ligament. Its periphery extends loosely downward under the fibers of the deltoid, backward and outward under the acromion, and inward under the coracoid. The roof and base are in intimate contact and

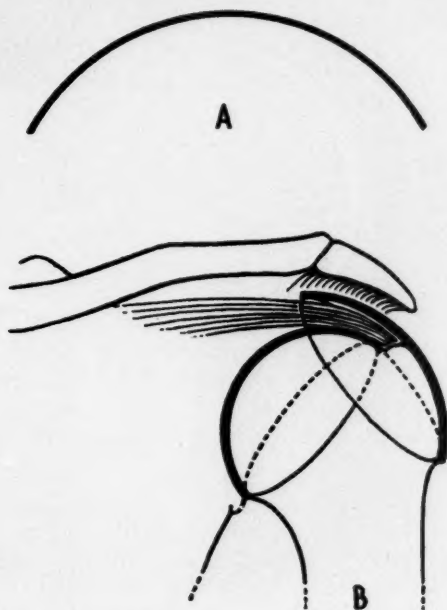


Fig. 1. A. This hemisphere is almost a counterpart in size and curvature of the articular surface of the true joint.

B. The hemisphere of the joint surface is slightly smaller than the hemisphere of the base of the bursa, which functions as an auxiliary joint.

From Codman: "The Shoulder" with kind permission of the author.

are lined with synovial membrane as thin as cobweb. This layer has the property of secreting just enough fluid to render the surfaces frictionless. A fine network of blood vessels lies under the membrane so that the secretion can be increased on demand. This arrangement also gives it the property of peritoneum in that congestion occurs very rapidly on occasions. The subacromial bursa is a very necessary part of the shoulder as demonstrated by the almost complete limitation of abduction and rotation when it is congested, so as to cause painful friction, and when it is firmly adherent.

A more graphic conception of this structure is possible, if we can for a moment imagine ourselves to be of such small physical proportion that we are standing in the center of the base of the intact bursa. We find we are standing on the highest part of a hemisphere which extends three-fourths of an inch in all directions to its circumference. Over our heads is another hemisphere of equal size, the roof of the bursa. These parts are joined at the periphery, not

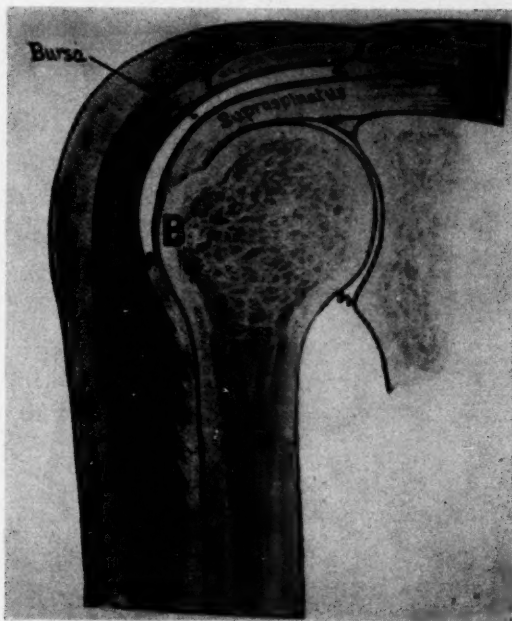


Fig. 2. Diagram to show insertion of supraspinatus tendon and relation of tendon to bursa.

From Codman: "The Shoulder" with kind permission of the author.

by a simple continuous fold, but by nictating folds which permit a wide excursion of the base, not only within the roof, but also completely around its periphery when the shoulder is put through its wide range of motion. It should now be clear that this bursa is a concavo-convex, circular cleft about  $1\frac{1}{2}$  inches in diameter which caps the upper and outer end of the humerus and its tendon insertions, separating them from the acromion process and the deltoid muscle (fig. 1).

The tendons of the short rotators alluded to above are hardly tendons in the general sense of the word. They are broad, flat, and about one inch in length. It is impossible to dissect them from the



capsule of the joint or from the synovial base of the subacromial bursa. They insert in a musculotendinous cuff within a half inch of the sulcus around the cartilaginous humeral head. Their intimate relation to the base of the bursa is the pertinent point in this connection as shown in the discussion to follow. This is particularly true of the supraspinatus tendon whose insertion lies directly under the midpoint of the base and just superior to the prominent greater tuberosity (fig. 2).

Clinically, bursitis at the shoulder may be classified as acute, chronic and latent.

The acute case consults his physician for relief of pain in the shoulder of varying intensity ranging from a bothersome "catch" to that requiring opiates at frequent intervals. Examination reveals muscle spasm about the shoulder girdle, limiting active and passive motion of the joint, localized tenderness in a small area lateral and anterior to the acromion process over the humeral head. There may be low grade fever and general malaise, the latter is probably secondary to the intense pain and loss of sleep. Hypersensitivity of the skin of the affected shoulder, pain at the insertion of the deltoid on the humerus, and pain in the supraspinatus muscle are fairly constant findings.

These symptoms and findings, together with the roentgenographic demonstration of calcification in the soft tissue about the affected joint, are sufficient to make a diagnosis of bursitis.

The chronic case gives a history of vague discomfort in the shoulder with exacerbations and remission, but never becoming severe in character or producing marked limitation of function or disability. Films of these cases show deposits which are in no way different from those found in the acute case with the possible exception that they may be slightly less extensive as a group.

The latent case is the one in which the deposits are noted incidentally in a film including the shoulder which was made for some other reason. These cases have never had symptoms referable to the shoulder. Again these deposits are morphologically indistinguishable from those seen in acute and chronic cases.

X-ray films of the shoulder not infrequently reveal the presence of lime salts in the soft tissue between the humeral head and the acromion. Painter first described such shadows in 1902 and regarded them as evidence of a thickened bursa. Surgery and autopsy findings have long since shown conclusively that such shadows are only occasionally in the bursa and that the usual site is in the tendons lying immediately beneath the base of that structure. This distinction is fine and contested by many, but nevertheless, it must be

made if we are to approach the subject critically. Improved technic and specialized interpretation in the making and reading of films enable us to state in most cases that not only is the deposit in a tendon and peritendinous tissue, but also state with accuracy in which tendon the deposit will be found in the given case.

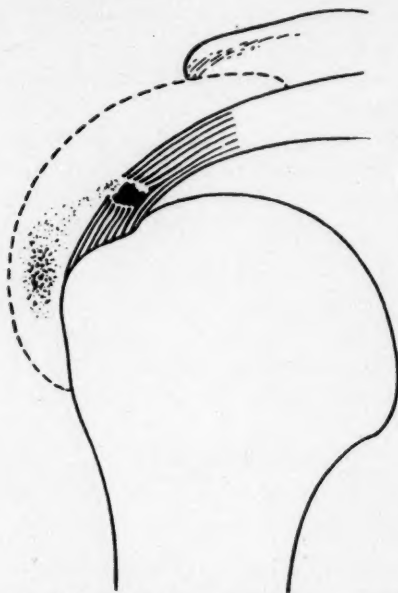


Fig. 3. Diagram to show perforation of floor of bursa and dissemination of deposit.

From Codman: "The Shoulder" with kind permission of the author.

To accomplish such results, it is necessary first, to be familiar with the relations of the tendons to the humeral head; second, to have a constant position of the humerus with regard to its rotation; third, to employ in some cases technic which will not penetrate deposits of light density. Oblique projections are made so as to "shoot around the head" with a series of films. Stereoscopic views are of little value because of superimposed bone which in many instances hides small deposits.

In a small percentage of cases, the visualized material will actually be in the cavity of the bursa. This is a result of its having ruptured through the base and becoming disseminated through the cavity of the bursa. Here, again, the shadow is characteristic in that it now delineates the extent of the bursa, and that portion of the sac extending below the tuberosities will contain radio-opaque ma-

terial casting a shadow in a position where we know there are no tendinous structures (fig. 3).

Pathologically, the findings are both enlightening and confusing. The roof of the bursa seldom shows marked pathologic changes other than congestion and thickening in the acute case. It reacts very much as does peritoneum in the presence of irritation. If lime salts are found in the bursa, they are not only a deposit in the sense of the word, but a part of the contents of the bursal cavity. If present, this material has come through a perforation in the base from its site of formation in one of the tendinous structures and has mixed with the fluid of the bursa to form a homogeneous mixture. Codman relates the interesting experience of having been able to remove the contents of the bursa intact and found that fibrin had been thrown out so as to form a watch glass shaped cast containing the calcium particles. The finding of this material in the bursa proper indicates that perforation has occurred only a short time prior to exploration. Serial x-rays in cases in which the material was not removed for fear of injuring the lining membrane or in unopened cases, show the deposit to be completely absorbed as soon as three weeks. This can best be explained by the phagocytic action of the leukocytes.

The usual finding upon opening the roof is a small mound-like swelling on the base with a white center and an injected zone about it not unlike a small boil. In this instance the deposit is seen through the floor of the bursa in its original site in the tendon. It may have formed years before and then only recently worked through to the floor of the bursa. This last step may have been climaxed by some unusual strain on the tendon producing a rupture of the few remaining fibers separating the deposit and the membrane of the floor.

When the base is opened in the region of the swelling, the calcareous material exudes with a consistency of zinc oxide ointment or tooth paste. It may be completely expressed with gentle pressure, but occasionally a curet is necessary to remove a less liquid accumulation. It has also been observed that the deposit may be confined in an endothelial lined capsule within the tendinous or ligamentous structure. This may be the chronic or latent case mentioned above.

Reports of microscopic, histologic and chemical studies of both the calcium deposit and tissue in cases of bursitis are surprisingly few in number. Regarding the microscopic picture of the deposit, all workers describe it to be composed of small oval bodies of homogeneous appearance. The particles vary in size from that of bacteria to the diameter of red blood cells. They have a regular, smooth outline and no visible internal framework or crystalline structures. Chemically, they prove to be almost entirely calcium

salts, one analysis showing calcium phosphate 55.4 per cent and calcium oxalate 44.2 per cent.

Sections of the tendinous tissue surrounding the deposit show non-specific inflammatory changes with necrosis and vascular granulations. These degenerative and regenerative changes are in keeping with those found in any tissue harboring foreign material. Sections of the walls of the bursa show increased vascularity with some cellular infiltration around the vessels. Giant cells of the foreign body type have been described. There is no report of organisms of any type having been found. Cultures on all cases opened by the authors have shown no growth.

Etiology and pathogenesis are all that remain to be discussed and much discussion has failed to bring any satisfactory conclusion. Many theories have been advanced, but all fall short of explaining the changes found in these tissues. All agree that the deposit of calcium in the tendon is the beginning. The majority also state that this change is present and silent for perhaps years before the onset of symptoms. Focal and systemic infection as the exciting agent is upheld by many. If such a focus can be found, it is easy to say, "there is your trouble." Unfortunately, such foci are too often lacking. Furthermore, the absence of organisms and the fact that operative wounds are always closed tightly without suppuration, casts more than a shadow of doubt on the infectious theory. We may also ask, "Why is the supraspinatus tendon the site most vulnerable to a systemic infection?"

Trauma as a predisposing factor seems to be undoubtedly a part, but not all, of the picture. Not infrequently the first pain is experienced after a twist or blow. This explains the acute onset, but not the presence of the deposit in the tendon. It may well be secondary to a preceding injury with small hemorrhage, but there is no blood pigment found on analysis of this material. Neither do we find such material deposited in tendons sutured following injury, or in tendons sutured experimentally to produce local necrosis.

Unbalanced calcium metabolism is offered, but is excluded by the lack of sufficient data and specific blood chemistry alterations.

The similarity of bursitis to true uric acid gout in the acute stages of both, as well as in their chronic and recurrent courses, is striking. The recent attempt to explain gout as an allergic phenomenon compels us to mention this possibility in connection with bursitis.

The knowledge that rupture or perforation of the calcium deposit into the bursa brings relief makes treatment specific. When this change is produced surgically the results are most satisfactory. This method is employed by us because we feel that direct vision is preferable to blind methods, such as needling. In addition, mul-

multiple deposits are occasionally encountered which could be easily overlooked in the x-ray films. Rupture by needling and irrigation is followed by a high percentage of cures in experienced hands. Diathermy, x-ray therapy and other non-surgical measures are employed with good results, but are condemned by many as being effective only by coincidental spontaneous perforation or subsidence of acute symptoms. The untreated case also eventually becomes free of symptoms, but the course may be long and suffering unbearable. Physical therapy is indicated following any type of treatment to rehabilitate the joint as soon as possible. Until proved to be entirely irrelevant, focal infection must be searched for and removed.

#### CONCLUSION

1. The pathogenesis of subacromial bursitis is not known.
2. On an anatomic and pathologic basis, the terms *tendinitis calcarea* or *peritendinitis calcarea* are more descriptive of this condition than the name subacromial bursitis.
3. Treatment is specific and subject to variations dependent on the skill and preference of the operator.



## REHABILITATION OF THE PHYSICALLY HANDICAPPED

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**T**HE man in the street is familiar with the crippled and disabled person who has made his adjustment by a fight against overwhelming odds. He is not aware, however, of the larger number who because of social attitudes are unable to make their adjustment, and therefore become dependent and unemployable. Congenital deformity, disease, street and industrial accidents, as well as war, are the sources of this large army of disabled and handicapped persons. The crippled and disabled have become a serious social problem. Society is uninformed of the productive possibilities of these individuals and how, under proper limitations, they are capable of wide and prolonged usefulness. As a result of false concepts of capacity to work, as well as psychologic prejudices, there have been developed social attitudes and legal limitations which seriously handicap the disabled in an effort to earn a livelihood. These barriers and prejudices are being gradually mitigated by humanitarian legislation designed to rehabilitate the disabled in occupations and industries for which they are suited.

Already forty-eight states have established official agencies for the purpose of assisting the handicapped in their task of earning a livelihood, thus removing the burden of relief or support from the state or the municipality. Through these agencies, a crippled adult may be trained in a suitable occupation, given physical restoration or provided with a prosthesis in order to increase his industrial efficiency and facilitate his employment.

In the pursuit of our objective, it is important to overcome many of the prejudices that employers have and to re-educate them to the desirability of engaging adequately trained and skilled workers who, though having an obvious physical defect, have compensated for that physical defect by a full measure of productivity as well as many social attributes of loyalty, patience, ingenuity and creative effort which have been stimulated by the realization of their inferior position.

Employers frequently commit the error of undervaluating the individual's capacity to work. It is often assumed that a physical defect causes limitation of functional activity and hence, limitation of industrial usefulness. This line of reasoning is invalid. While it must be conceded that the disability may limit the number of oppor-

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tunities offered to disabled persons, it is far from correct to assume that a physical handicap always means incapacity to work.

A case in point is that of a 40 year old painter, who, following a fall from a scaffold, suffered a fractured spine and spinal cord injury with subsequent spastic paralysis of both lower extremities. After a prolonged period of hospitalization and after-treatment, his disability was still so severe that he was certified as totally disabled. Ten years later he appeared at the office of the New Jersey Rehabilitation Commission seeking employment. He was able to get along with a rather awkward gait, but without the aid of crutch or apparatus. Surprised by his application, we were amazed to learn that he had been working for a period of ten years as a structural-iron worker in the construction of the tallest skyscrapers in New York. His employer, for whom he had worked regularly for ten years, had gone out of business; and although he had received excellent credentials, no one would hire him because he was a cripple.

How do these physically disabled persons manage to make their physiologic adjustments? How do they accommodate themselves to the unusual demands made by disease or by congenital or acquired defects? The answer will depend on the presence of human safety factors. The human organism must maintain its normal function in the presence of disease or it dies. This is accomplished by drawing upon extra resources in its own structure. An individual can get along with one-quarter of a lung capacity, with one-third of a kidney, with one-quarter of a liver, without a stomach, without a large intestine. Among these safety factors one notes the excessive amounts of ferments in the digestive tract, the ability to substitute one foodstuff for another. The kidney, for example, can eliminate much more water than it is usually called upon to do, as in diabetes insipidus. Muscles are capable of more work than they are ordinarily called upon to perform. One structure may substitute for another, such as the skin for the kidney. It is through these factors of self-repair, regeneration, hypertrophy, and vicariousness of function that the body is able to combat its environment. This role of adaptation in the rehabilitation of the physically handicapped is an important one. It is a biologic and natural process and consists of the continuous adjustment of internal conditions.

Personality maladjustment plays an even more important role in the causation of incapacity to work than the physical deformity; it may be so great as to suppress completely the individual. Conversely, the organic defect may act as a stimulus to overcompensation, so as practically to eliminate the physical defect from consideration. The majority of us are equipped with potentialities which have not been developed to their fullest extent. Yet with this incom-

plete development good performances are turned out, just as our ancestors produced great work with imperfect tools. It is possible for a man with defective organs actually to develop an ingenious technic to overcome the rigors of his environment. He may pay a great deal of attention to detail, devise more unerring short cuts, and undergo a more intensive training. Great and really worthwhile accomplishments have been achieved by individuals through the exercise of powers requisite to meet these demands.

The first step in any plan of rehabilitation is physical restoration. By this we mean a complete plan of medical and surgical treatment including diagnosis and the use of all the scientific methods to improve the individual to the point where he can take his place with the so-called normal individual. Cure in this sense means not only freedom from pain and other symptoms of disease and accident, but preparing the individual for useful manual and mental work according to his ability and according to his needs.

The second step is that of vocational guidance and training. While these agencies do not consider themselves to be magicians or clairvoyants, nevertheless a large body of experience has been developed on the basis of which the physical handicap can be assisted in planning for his future vocation or career. An intelligent analysis of his entire background helps to provide a basis for deciding on a definite line of work.

Finally, it is important to utilize all of this training and securing for this individual a place in the shop, in the factory, in the office, and in general industrial life in order that he may become self-supporting.

#### PHYSICAL RESTORATION

The goal of rehabilitation is the improvement of the mental and physical powers of the disabled person in order to meet the competition of those who are free from physical defects. Indication has already been given as to how these powers can be improved through vocational training. It now remains to describe the role of physical restoration in the rehabilitation of the physically handicapped.

The large group of the disabled who seek the services of rehabilitation agencies frequently have disabilities which may be corrected, wholly or in part, by medical or surgical measures. Every effort should be made to discover whether the maximum physical restoration has been obtained, even though the disability is of long standing. This may be accomplished in three ways: (1) by surgery, (2) by functional re-education, and (3) by prosthesis.

*Rehabilitation Surgery.* Through the use of well-recognized orthopedic operations, physical disability may be reduced and function enhanced. Ankylosed joints may be made movable through arthro-

plasty; stiff and limited joints such as the knee may be improved by capsuloplasty or synovectomy; ununited fractures are stabilized by bone grafting; flail joints are immobilized by arthrodesis; and paralytic deformities are improved by fixation operations on the joints involved or by tendon transplantation. In considering any surgical plan the objective must always be the ultimate restoration of the individual to a job. The operation may, therefore, be designed for specific ends or only for local improvement. The necessity for surgical measures is illustrated in the following cases:

A nineteen year old aviator crashed, sustaining multiple injuries that threatened his life. A fractured skull, facial paralysis, compound fracture of the right elbow, a compressed fracture of his spine, internal injuries, compound fracture of the right leg, and paralysis of the left leg with foot drop were the immediate sequelae of his accident. He was seen four months later and was found to have made a fairly good constitutional recovery. However, he was suffering from so many skeletal and functional disabilities that the hope of rehabilitating him physically or vocationally seemed altogether remote. He had developed a kyphosis of his spine, ankylosis of his right elbow, had a draining osteomyelitis of his right ankle and a paralysis of his left leg. A series of operations were undertaken to improve his physical condition. A bone graft stabilized his weak spine; an arthroplasty gave him motion of his right elbow; an astragalectomy removed the focus of infection in his foot, permitting it to heal in an extreme varus position, later corrected by osteotomy; a Campbell bone block performed on the left foot helped to stabilize the ankle, permitting a balanced gait. Now three years after the accident the patient is able to walk without the aid of any apparatus or support and is at present completing a course in aviation engineering with excellent grades and with a definite opportunity for employment.

Reference has already been made to the natural aversion toward the deformed and disabled. Rehabilitation surgery not only increases function, but also improves the cosmetic appearance. In this way, the attitude of repugnance may be eliminated. The lessons learned in the World War in the field of plastic surgery have been applied to the problems of civil life with extraordinary success. Improvement in the physical appearance is an important factor in helping the disabled person reach his objective. By means of plastic surgery not only is the cosmetic defect eliminated, but the function of the part may also be improved.

An eighteen year old boy was referred to the Rehabilitation Clinic because of a supernumerary finger. It was impossible for him to secure employment because of his extra finger. He was repeatedly told that it would be dangerous to employ him because "you have too many fingers," implying that he would be prone to catch one of his fingers in a machine. The removal of the supernumerary finger made him an apparently normal person, and it thus became easier to secure employment for him.

**Functional Re-education.** In many cases it may be necessary to complete the entire plan of physical rehabilitation before vocational

training or employment becomes feasible. A tailor, for example, who sustains an infection in his hand, leaving a disabling stiffness in the hand and fingers, must often reconstruct his social and industrial life. Two courses may be open to him, depending upon the extent and severity of the disability. After his discharge by the physician, he may seek employment at a very much reduced earning capacity, necessitating a re-adjustment to a lower standard of living. On the other hand, he may find it more advisable to obtain further medical aid with a view to improving the physical condition of his hand. By a course of intensive after-treatment, followed by the development of the remaining physiologic functions of the hand, the disabled person may find it possible to return to his former vocation and employment. This should always be the primary goal of the rehabilitation service. The change of vocation is a severe stress on the disabled person's morale, especially if a reduced earning capacity is entailed. It is more rational to utilize medical and physical methods to overcome the physical disability and thereby prepare the disabled individual to return to his former work.

*Occupational Therapy.* There is no better means of achieving this latter objective than through occupational therapy. In addition to massage, splinting and mechanical treatment, maximum functional restoration of an injured part can be obtained through systematic and active use. In addition to the improvement of physical disabilities, psychologic attitudes and morale are also aided by these procedures. Occupational therapy received the greatest impetus immediately after the World War. It has been applied with equal success to those disabled in industry and civil life. Curative workshops have been established throughout the United States, a few associated with hospitals. The effect of work treatment in the rehabilitation of disabled persons may be noted in the following case:

Picked up by a social worker in the municipal almshouse, G. F., aged 29, was admitted to the curative workshop with little hope of readjustment, since his past failure in industry made any effort at rehabilitating him seem futile. Even to himself the idea of training was a waste of time and a perpetual joke. The spastic hemiplegia he had suffered as the result of a birth injury was sufficient reason for making him a permanent and hopeless invalid. Though his attendance was forced at the beginning, he later manifested such physical and mental changes through occupational therapeutic practices, that we were able to secure employment for him a year after admission to the shop. Continual practice, training and application in the use of his remaining good arm qualified him for the position of an automobile painter. He has remained gainfully employed for the past six years with the same organization.

*Prostheses.* Among the large group of the disabled who seek the services of rehabilitation agencies, the amputation case is one that requires careful consideration. Many of these disabled persons rehabilitate themselves because of educational or vocational quali-



ties that are not interfered with by their handicap, because of well-adjusted personalities, or because of fortuitous circumstances. On the other hand, there are a large number who are unable to help themselves, and so seek the aid of rehabilitation organizations. Employment is facilitated by providing these individuals with artificial appliances. The prosthesis serves to remove the psychologic aversion toward the crippled by replacing his missing member and offsets the economic prejudice of the employer through increase in the handicapped person's industrial efficiency.

A man who wears an artificial leg is the least disabled of all cripples. Such a device not only substitutes for the weight-bearing function of the natural leg, but also eliminates the repelling attitude caused by the defect. Fitting an artificial leg is not a difficult task, except in unusual situations.

Although the fitting of an artificial leg is a comparatively simple matter, the problems which face us in the fitting of the appliance to an arm stump are extremely difficult.

The principal problem is that of making the stump play a supporting role in daily life and work. The expectations of amputated persons are frequently too great. They hope to be capable of doing absolutely independent work through the artificial appliance. Unfortunately, the types of appliances now in use have not entirely fulfilled this desired objective.

The advice of the physician must necessarily be based upon the fact that the use of the prosthesis, however clever it may be, is a limited one, since the safety factors retained by the body in its capacity for compensation may be more valuable than the best mechanical construction. For example, a one-armed person learns very rapidly to dress or to undress, wash, shave and comb his hair, as well as to write with the remaining arm. The left hand gradually becomes the right hand and assumes all the tasks previously fulfilled by the right.

Only a small proportion of those supplied with artificial arms wear them and a still smaller proportion actually use them. A survey made in Germany over a long period of years, among a group of 7,000 arm amputations showed only 129 or 1.8 per cent who wore a mechanical arm. In another survey of 729 cases of cineplastic amputations, 273 or 37.4 per cent wore their prosthesis from one to thirteen years.

In the cineplastic arm, function is achieved by natural muscular control. The remaining muscles in the amputated stump are utilized by means of pegs, passed through canals in the muscles and attached to levers operating the artificial hand mechanism. In this way, the

physiologic action of the stump muscles has been restored. The biceps and triceps muscles in the upper arm, and the flexors and extensors of the lower arm control the grasp and release of the fingers of the artificial hand. Thus the stump retains its real task of guiding the hand without other problems added to it, as in the mechanical arm. In this way, it can accomplish that task more effectively. Though the fingers of the artificial hand have no feeling, natural control is nevertheless exerted by the muscles in the act of grasping thereby permitting a close approximation to natural hand function.

The use of the cineplastic amputation in selected cases is of distinct advantage in the rehabilitation of arm amputations. Through the natural control obtained by this procedure the individual is able to utilize the assistance of the amputated arm in the performance of his daily tasks; in increasing his efficiency, he restores his confidence and ability to compete with others. He is thus equipped to partake of a fuller life without asking for any special consideration because of his disability.

#### SUMMARY

We have seen how society is not yet fully informed of the productive possibilities of crippled and disabled persons and how under proper limitations they are capable of wide and prolonged usefulness. Little interest is shown in seeing their capacity to work become productive, presumably because it is difficult to find a place for them in industry. Actually, this difficulty is largely due to social and economic prejudices. If I have emphasized these social prejudices, it is because they are so important in explaining the maladjustment of the disabled.

The economic choice therefore is one of considering either the whole group of disabled as a burden for which asylum and care must be provided, or of rehabilitating them in occupations and industries for which they are suited.

The latter goal can be reached in several ways. Through special training the physically handicapped person may become qualified to find his place with the normal worker.

His greatest hope, however, lies in physical restoration. Many disabled individuals, if adequately treated, will regain their former working capacity. Although a certain proportion will require special surgical and prosthetic services, the larger number will achieve their adjustment through functional re-education and adaptation.

## HYPERPARATHYROIDISM

### Report of Nine Cases

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**H**YPERPARATHYROIDISM is a disease entity caused by oversecretion of one or more of the parathyroid glands. The entire picture, clinical and pathologic, with the exception of the small tumor or hypertrophy of one or more of the glands not usually obvious, is dependent on the disturbance of calcium metabolism. This consists of a mobilization of the calcium stored in the bones, a high level of calcium in the blood, and an increased excretion of calcium by the kidneys.

The parathyroid glands were first described by Sandstrom<sup>1</sup> in 1880, but their function was not recognized at that time. In 1900 Vassale and Generali<sup>2</sup> showed that their removal resulted in tetany. MacCallum and Voegtlin<sup>3</sup> in 1909 reported uniform reductions in the blood calcium levels following parathyroidectomy, demonstrating the influence of these small glands on calcium metabolism.

The clinical picture of an advanced form of the disease with extensive bony changes was described by von Recklinghausen in 1891 but he did not connect it with changes in the parathyroid gland. Since that time the bony form of this disease has been known as von Recklinghausen's disease or osteitis fibrosa cystica. It was not until thirteen years later, in 1904, that Askanazy<sup>4</sup> first described an autopsy on a patient with von Recklinghausen's disease in whom a parathyroid tumor was found, but even then he failed to correlate the two conditions. In 1907 Erdheim<sup>5</sup>, on finding enlargement of the parathyroid glands in rickets and osteomalacia, suggested that enlargement of the parathyroid gland in bone diseases was the result rather than the cause of the disorder.

The true relationship of the parathyroid gland to von Recklinghausen's disease was finally proven by Mandl<sup>6</sup> of Vienna in 1925. Following Erdheim's theory he treated a patient with von Recklinghausen's disease by successful parathyroid gland transplants. The patient, however, became worse rather than better. The neck was then explored, a parathyroid tumor was found and excised, the parathyroid transplants were removed, and the patient, who had been bedridden with severe pain, showed rapid improvement, his health approaching normal. Since the report of this case by Mandl in 1926

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there have been an increasing number of patients treated by surgical removal of one or more parathyroid tumors or hypertrophied glands. With the more widespread use of chemical analyses of the blood for calcium and phosphorus other clinical types of the disease, hyperparathyroidism, have been identified and successfully treated by operative removal of the offending tissue.

#### PATHOLOGY

The pathology of hyperparathyroidism centers around the primary condition—an increased functioning of one or more of the parathyroid glands. This may be the result of a single adenoma (79 per cent of the cases), multiple adenomas (7 per cent), or diffuse hyperplasia of all the parathyroid glands (14 per cent). The adenomas are most likely to be composed of chief cells and the hyperplasias of clear water type of cells, though either the tumor or the hyperplasia may be composed predominantly of either type of cell. (Castleman and Mallory<sup>15</sup>—162 collected cases.)

The pathology dependent on the disturbance of calcium metabolism is far more widespread and striking than the small tumor or hyperplasia of the glands. This involves the bones and kidneys predominantly but may affect many other organs.

The bone changes are secondary to decalcification brought about by mobilization of calcium from this storehouse as a result of the oversecretion of one or more parathyroid glands. With decalcification there is an increase in the number of osteoclasts and osteoblasts, together with an extensive fibrosis within the bone. This may go on to cyst formation or the osteoclasts may proliferate to form solid tumors. The bones become softened and weakened, the long bones may bow or break, and the vertebrae may collapse. The final result may be any degree of bone change from a slight osteoporosis to the most extreme deformities sometimes found in advanced cases of osteitis fibrosa cystica.

The kidney changes are the direct result of the extensive mobilization of calcium from the bones, its high level in the blood, and the excretion of large quantities of calcium and phosphorus by the kidneys. This may be deposited in the kidney tubules or in the substance of the kidneys (nephrocalcinosis), causing marked impairment in the renal function, or it may be precipitated in the urine, resulting in the formation of stones which may be located in the kidney pelvis, ureter or bladder. These may produce partial obstruction with secondary dilatation of the ureter and pelvis, or infection may be superimposed with the development of pyelonephritis.

In the stage of acute intoxication with parathormone other organs of the body may show local necrosis and degeneration of tissue as

shown by McJunkin, Tweedy and Breuhaus<sup>44</sup> in rats and by Cantarrow, Stewart and Housel<sup>33</sup> in dogs. In one of our cases reported by Hanes there was extensive focal necrosis involving particularly the connective tissue throughout all the organs. This was most marked in the kidneys, liver, heart and blood vessels. These injuries are probably followed by calcification in many cases. Such calcification has been reported in the heart, lungs, arteries, thyroid, kidneys, spleen, skin, walls of the parathyroid tumor and practically every organ in the body. This calcium deposit is frequently in the form of fine granules, located especially in the elastic and fine connective tissue fibrils.

#### SYMPTOMATOLOGY

The symptoms of hyperparathyroidism are related almost entirely to the disturbance of calcium metabolism and its direct and remote results. Not only are there usually no symptoms from the tumor, but it is usually not palpable and can be found only on careful exploration of the neck and rarely the mediastinum. When a tumor can be palpated in the neck it is more likely to be an adenoma of the thyroid than a parathyroid tumor. The symptoms may be classified under four main headings, dependent on the following etiologic factors:

1. Hypercalcemia.
2. Osteoporosis and skeletal changes.
3. High calcium excretion with its deposition in the kidneys.
4. Toxic manifestation due to oversecretion by the parathyroid tissue.

Hypercalcemia gives symptoms of weakness, lassitude and generalized muscular atony or the opposite of hypocalcemia (hypertonicity, excitability and tetany). These patients may also have constipation, anorexia, loss of weight, nervousness, faulty memory, and diminution in visual and auditory acuity.

Oversecretion of parathormone may result in certain toxic manifestations not directly due to the hypercalcemia. This may account for the nausea, vomiting and abdominal pain seen in certain cases. One of our patients who died apparently of intoxication and hypercalcemia (Ca 22 mg. per cent, P 4.8 mg. per cent and phosphatase 23 Bodansky units) showed a temperature elevation, rapid pulse, and great weakness and nervousness.

*Skeletal changes:*—Pain of a dull aching character located over the lower back or long bones is usually the first symptom referable to the changes in the bones. This is aggravated by exercise, may become quite widespread and so severe as to require sedation. Cysts and solid tumors may develop in any of the bones, spontaneous fractures may occur with slight effort, and be followed by mal-union or



non-union. Further deformities result from bowing of long bones, collapse of the vertebrae, pelvis and chest, so that the resulting deformities may be extreme with a remarkable loss in height. With it all the patient may be incapacitated from deformity and agonizing pain and we have the advanced stage of von Recklinghausen's disease.

The symptoms referable to the kidneys may be only polyuria and polydypsia. In a considerable proportion of cases there is a history of kidney colic extending over many years and the patient may have any of the complications of renal stones. At times the calcium and phosphorus may precipitate out in the bladder and be expelled at the end of urination as "sand" or "milky urine." In certain patients with long-standing disease there may be all the symptoms of severe renal insufficiency resulting from a deposition of calcium in the kidney or from an extensive pyelonephritis secondary to deposition of stones in the pelvis with hydronephrosis and superimposed infection.

#### DIAGNOSIS

Hyperparathyroidism can be more readily diagnosed if one has in mind the different clinical types which are manifestations of the underlying pathologic conditions and produce the symptoms noted above. These are as follows:

TYPE 1. Von Recklinghausen's disease or osteitis fibrosa cystica represents the form first recognized and may be in any stage of development from an osteoporosis and scattered cyst or tumor formations to the far advanced form of the disease with extreme deformities.

TYPE 2. Osteoporosis or an extensive decalcification of the bones without cysts or tumor formation.

TYPE 3. Renal changes dependent on calcium deposits in the pyramids or pelvis with the resultant impairment of function and complications.

TYPE 4. Toxic manifestations with nausea, vomiting and abdominal pain.

In addition to these types which are well known we will undoubtedly, with additional utilization of blood chemistry, find among those patients who complain of weakness, lassitude, nervousness, anorexia and loss of weight certain individuals with a high blood calcium, low blood phosphorus and high phosphatase, and a diagnosis of parathyroid overactivity will be made more and more frequently in its early stage. As in the early years of recognition of any disease, we are now seeing the advanced stages. With education of the profession and public these should be seen much less commonly, and many patients should be saved from the deformity and renal insufficiency which persist even though the hypercalcemia is corrected by removal of the excess parathyroid tissue.

At present the diagnoses are most commonly suggested to the urologist as a result of the characteristic kidney changes with a flocculent deposition of calcium in the pyramids or may be picked up by routine determination of the blood calcium and phosphorus on all patients with kidney stones. The orthopedist, as a result of the characteristic bone changes, may be the first to diagnose a certain number of cases, and should determine the blood calcium and phosphorus level on every patient with a questionable bone lesion. The roentgenologist, on the basis of these same lesions, is in a highly strategic position to pick up suggestive changes in the bones or kidneys and call them to the attention of the referring physician. In the future the diagnosis may be suggested to the family physician or the diagnostician by the symptoms of hypercalcemia.

Certainly the condition should be kept in mind, and whenever there is the slightest suggestion of this disease a quantitative chemical determination of the calcium, phosphorus and phosphatase in the blood should be made, and the final diagnosis will depend to a great extent on this. The high blood serum calcium—12 to 23.6 mg. per cent (normal 9 to 11), low serum phosphorus—1.5 to 2.5 mg. per cent (normal 3 to 4) and the high phosphatase (enzyme capable of splitting organic phosphorus compounds) average 20 Bodansky units (normal 1.5 to 4) are practically diagnostic. Hypercalcinuria and hyperphosphaturia accompany the blood changes but these determinations are laborious and are not necessary.

With the advanced bony changes there may be partial destruction of the hematopoietic system with resultant anemia and leukopenia.

In differential diagnosis one must keep in mind that metastatic malignancy or multiple myeloma may give a high serum calcium but in these the serum phosphorus is also elevated. Rickets and osteomalacia may be associated with a low serum phosphorus but the serum calcium is not elevated.

The urine should be studied for Bence-Jones protein.

It should also be kept in mind that in the advanced stages with a very high serum calcium the serum phosphorus may go up and this should be considered a critical condition. One of our patients died with a high serum calcium and phosphorus. (Ca 22 mg., P 4.8 mg., phosphatase 23 Bodansky units.)

#### TREATMENT

It is evident to everyone that surgical removal of the excess or over-secreting parathyroid tissue is the treatment of choice. The only difficulty in such treatment lies in locating the parathyroid glands made troublesome by their small size if they are not patho-

logic and therefore not enlarged, and by the wide variations in their location. Embryologically they arise from the lateral anlagen of the third and fourth pharyngeal pouches and therefore must be located between the middle cervical fascia which lies just beneath the sternohyoid and sternothyroid muscles, and the prevertebral layer of the deep cervical fascia which lies on the anterior surface of the longus colli muscles and since the structures in the neck migrate caudally they may be found between the above noted fascial planes anywhere from the level of the pharynx to an indefinite distance in the mediastinum.

Since the tumors may be multiple or the disease may be due to hyperplasia of all the parathyroid glands, a thorough search of the neck should be made. In every case it is advisable that the operator assure himself that he is leaving some parathyroid tissue. In the patient showing enlargement of more than one gland this is imperative since the patient will likely die of tetany if all the parathyroid tissue is removed.

Most of the tumors are located beneath the inferior poles of the thyroid gland, next in frequency beneath the superior poles but they may be in the thyroid gland, between the trachea and esophagus, posterior to the esophagus, or in the anterior or posterior mediastinum.

The surgical approach is similar to that for thyroidectomy. An adequate exposure can be insured by making a relatively long incision and by cutting across the ribbon muscles in the neck. The lateral lobe of the thyroid gland should be mobilized by dividing the middle thyroid vein and rolling the lobe medially. The tumor may be large, firm and readily palpable, or small, soft and molded into its position so that it is difficult to palpate. However, it is always large enough so that it is needless to examine microscopically small bits of tissue, the reported cases including our present series ranging in size from that of a hazel nut to that of an orange.

If the tumor is not immediately evident the operator must explore the areolar tissue in the angle between the thyroid gland and the trachea. The recurrent laryngeal nerve should be identified so as not to damage it, and the terminal branches of the inferior thyroid artery should be followed out since they usually supply the blood for the parathyroid glands. The trachea and esophagus are exposed since the glands may be between or posterior to these structures. The dissection is carried up to the larynx and down to the mediastinum. The mediastinum may be examined as advocated by Churchill and Cope<sup>27</sup> by passing one finger into the posterior mediastinum behind the esophagus and trachea and another into the anterior mediastinum beneath the middle cervical fascia, palpating the structures

between them. A parathyroid tumor if found can be delivered into the neck and removed since its vascular pedicle comes from the neck.

The more gentle and atraumatic the dissection with meticulous hemostasis, the more normal the appearance of the structures and the less danger there is of confusing the smooth, glistening, light brown parathyroid tumor with a hemolymph gland or with thyroid tissue.

When there is hyperplasia of all the parathyroid glands Cope advises removal of all but one and subtotal resection of that. He cautions, however, that since there is no safe replacement therapy some other method such as roentgen ray therapy may prove to be the treatment of choice.

#### PROGNOSIS

Immediately following operation there is danger of tetany, this being greater in those patients who show marked bony changes with a high phosphatase. This should be treated prophylactically by giving large amounts of calcium orally, and the blood calcium should be followed closely. If it drops to 7 or 8 mg. tetany is likely to develop. Before the blood calcium reaches dangerously low levels or when there is evidence of mild tetany such as cramps or tingling, the patient should be given 10 c.c. of 10 per cent calcium chloride or 10 to 20 c.c. of 10 per cent calcium gluconate intravenously and this should be repeated every three or four hours. Parathyroid hormone may be given but loses its effect if repeated over a long period of time. Viosterol in large doses seems to be of much benefit. Where parathyroid tissue has been left the tetany is usually transient and it is only necessary to tide the patient over the first few days.

Kidney damage when once received is likely to be permanent, stones may have to be removed, pyelonephritis given appropriate treatment, and the patient placed on such a regime as his impaired kidney function demands.

The bones will likely show signs of increasing calcification, but the deformities will persist and may have to be corrected. The pain and tenderness in the bones will disappear rapidly. The diffuse calcifications sometimes seen in the organs and soft tissues will show little or no change.

The appetite improves, the patient gains weight, fatigability and lassitude disappear and there is general improvement in the feeling of well being. The patient who is bedridden is soon able to be up. Constipation may be relieved and, with the exception of permanent damage to kidneys or bones, the patient's general condition approaches that seen in normal health.

The best prognosis can be given in those patients who are treated before there are extensive changes in the kidneys, bones and other organs, and in such the outlook for complete recovery is good.

#### CASE REPORTS

##### TYPE 1. *Von Recklinghausen's Disease of Bone*

CASE 1.—Mr. J. N., aged 34, was first seen on the Urological Service in June, 1935, complaining of difficulty in walking for four months and pain in the back for two months. He could walk but with "universal pain." Two months previously he had developed pain in his right costovertebral angle which radiated through to the right flank. He had had intermittent attacks of frequency and nocturia (8 times per night), fever occasionally. Two months previously he had fractured his clavicle. His appetite had been poor and he had lost 25 pounds in weight during the preceding three months.

Physical examination showed a poorly developed and nourished, pale, weak, chronically ill male. There was kyphosis of the lumbar spine, scoliosis of the thoracic spine, both clavicles were deformed, the bridge of the nose was flattened, and pressure over the tibia elicited tenderness on both sides. The thyroid was twice normal size, the enlargement being mostly on the right. The basal metabolism was +36. The heart was not enlarged, the peripheral vessels were thickened and the blood pressure was 160/90. The tendon reflexes were hypoactive.

Urine showed a trace of albumin, a few white blood cells, occasional granular and hyaline casts, and a trace of Bence-Jones protein.

The stool examination showed heavy hook worm infestation with occult blood present.

X-rays showed general decalcification of the bones, old fractures of both clavicles and several ribs, and collapse of several vertebrae. The patient while in the hospital had a spontaneous fracture of the right fibula while standing on the scales to be weighed.

Microscopic examination of tissue taken from one of the ribs was diagnosed as giant cell tumor.

OPERATION: On Aug. 21, 1936, an adenoma of the parathyroid was removed from beneath the right lobe of the thyroid, behind the capsule of the gland. It weighed 10 Gm. and measured 5 by 2 by 1.5 cm. Partial thyroidec-tomy was also performed.

PATHOLOGIC EXAMINATION: Adenoma of the parathyroid and hyperplasia of the thyroid gland.

POSTOPERATIVE COURSE: The patient was given calcium chloride and oleum percomorphum by mouth and 5 c.c. of 20 per cent calcium intravenously the day of operation and the high calcium and high vitamin diet was continued. He developed Chvostek and Trousseau signs but did not go into tetany. These soon passed and convalescence was otherwise uneventful.

##### TYPE 2. *Von Recklinghausen's Disease of Bone*

CASE 2.—Mrs. B. F. S., aged 53, came to the Medical Dispensary Aug. 15, 1938, complaining of pain in her bones of three years' duration. During this time she had become progressively weaker. Three years previously she had fallen and fractured the left patella. Fifteen months before admission she had suffered a spontaneous fracture of the left humerus and in July she had frac-



tured the right fifth metacarpal. Following the latter two fractures a lump had developed at the site of the fracture. For three years she had suffered much from cramps in the feet, had become progressively more round-shouldered.

Physical examination showed a deformed, undernourished, restless, pale, but cooperative and optimistic, white woman of 53. She had large red tonsils, an enlarged heart with a systolic apical murmur. The blood pressure was 245/135. Hemoglobin was 65 per cent. There was marked generalized motor weakness and extensive bony change. The chest was narrowed laterally and increased in diameter. The spine showed lumbar scoliosis and thoracic kyphosis. A hard mass (2 by 2 cm.) overlay the point of injury of the fifth metacarpal bone while there was a fusiform mass about 7 cm. in diameter in the upper third of the upper left arm. Percussion over all the bones elicited tenderness.

The urine showed many hyaline and granular casts and 1+ albumin.

X-rays showed generalized bony decalcification. Bone cysts were seen in the right eleventh rib near its outer end, in the upper third of the left humerus, and in the right ulna. There was evidence of old fractures in the left humerus and right fifth metacarpal bone. All the findings were characteristic of parathyroid disease. There was no evidence of calcification in the kidneys.

OPERATION: On Sept. 3, 1938, an adenoma of the parathyroid gland was located caudal to the lower pole of the left lobe of the thyroid and was excised. It measured 4 by 3 by 2 cm. and was about equal in size to the left lobe of the thyroid. The vascular pedicle was from the inferior thyroid artery. Pathologically it was a chief cell adenoma.

CONVALESCENCE: Convalescence was uneventful. There was no evidence of tetany. At the end of four months the patient had gained 10 pounds but still felt weak and had pain in her bones but did not have to take medicine. Chvostek and Trousseau signs were negative. There was no tenderness over the bones. She still had advanced hypertensive cardiovascular renal disease. The prognosis was considered poor because of the marked renal impairment. Maximum phenolsulphonphthalein output per half hour during the first two hours was 5 per cent.

TYPE 1, 2 and 3. *Von Recklinghausen's Disease, Osteoporosis, Calcium Deposits in the Renal Pelvis and Parenchyma.*

CASE 3.—Mrs. E. W. S., aged 49, came to the Urological Clinic in April 1938, complaining of kidney stones of 17 years' duration. She had begun having kidney colic following childbirth in 1921, having a large number of attacks over a period of seven years, during which time she had passed many stones. She was then well until 1935 when she had begun having chills and fever, which were attributed to pyelitis. Since then she had had frequency (2 hours), nycturia (3 to 4), and urgency. She had had a constant dull ache in both flanks for seventeen years, had lost considerable weight, and had had arthritis in her right knee for seven months.

Physical examination showed a poorly developed and nourished, chronically ill woman. There was moderate dorsal kyphosis and "pre-tibial bursitis" on the right. The thyroid was not enlarged. The heart was normal in size. The blood pressure was 150/90. In the left upper quadrant was a non-tender palpable mass thought to be an enlarged kidney. The tendon reflexes were hyperactive.

X-ray films of the abdomen showed both kidneys well outlined and enlarged. There were several calculi in the lower portion of the left kidney, the larger of which measured 4 by 2.5 cm. in diameter. There was also a large calculus

in the pelvis of the right kidney that measured about 5 by 2.5 cm. in diameter. The bones showed generalized osteoporosis with several small cystic areas in the right ilium and a large irregular cystic area in the left ilium that measured about 6 by 2.5 cm. in diameter.

X-ray films of the chest showed a moderate amount of peribronchial thickening, a calcified gland opposite the right hilum, and a heart normal in size and contour. There was considerable osteoporosis of the bones of the thoracic cage. Films of the right knee showed an irregular, cystic area involving the upper 7 cm. of the right tibia anteriorly. The cortex was apparently broken through near the tibial tubercle but there were numerous trabeculations extending into the cyst.

**OPERATION:** On April 14, 1938, a mass located beneath the lower right pole of the thyroid was excised. This adenoma weighed 7 Gm. and measured 5 by 3.5 by 1.5 cm. Its gross appearance suggested an adenoma of the thyroid, but microscopic examination revealed that it was a chief cell adenoma of the parathyroid.

**CONVALESCENCE:** Her postoperative course was uneventful except for pyelitis and poor kidney function.

**TYPES 2, 3 and 4. *Osteoporosis and Stone Renal Pelvis, Parathormone Poisoning.***

**CASE 4.**—Miss V. S., 54 years of age, was first seen in the X-ray Department in 1935 when she was referred by a physician for x-ray studies because of a vague gastric disturbance characterized by anorexia and nausea without vomiting. X-rays were negative except for a stone in the left renal pelvis and general atonicity of the stomach and intestines. The hemoglobin was 87 per cent. All studies including x-rays were negative except for a blood chemistry examination. This showed a calcium level of 14.6 mg. and a blood phosphorus of 1.75 mg. This finding was reported to the referring physician by the roentgenologist as unexplainable except on the basis of a parathyroid tumor.

Nothing further was heard from the patient until October 1938, when she entered the hospital again complaining of severe attacks of nausea and vomiting coming on every two to three months and lasting one to three weeks. There was also burning in the pit of her stomach. She was weak and nervous, and slept poorly. She had no pain in the bones with the exception of an occasional backache. She had nycturia (3 to 4), and frequency of urination (every 2 to 3 hours) during the day.

Physical examination showed a poorly nourished, dehydrated and acutely ill woman with a blood pressure of 144/92, slight enlargement at the left inferior pole of the thyroid, a diffuse forceful impulse over the precordium and thickening of the arteries. Otherwise the examination was negative.

Blood chemistry showed the calcium to be 18 mg., phosphorus 5.5 mg., and phosphatase 36.9 Bodansky units. Plasma n. p. n. 39 mg.

**X-RAYS:** The skull showed an irregular density with questionable or very slight areas of decalcification. The long bones showed moderate loss of calcium and there was calcification of the blood vessels. The bony thorax showed moderate decalcification. The urinary tract was negative for calcification.

The urine showed a slight trace of albumin, but no Bence-Jones protein, an occasional white and red blood cell and the benzidine test was positive.

**OPERATION:** On Nov. 5, 1938, we excised a parathyroid adenoma measuring 1.5 by 1.5 by 0.6 cm. located on the right side in the lower neck between the trachea and the esophagus.

**COURSE:** Postoperative convalescence was uneventful except for some indigestion following meals. There was no evidence of tetany.

Six weeks after operation the patient was free of abdominal symptoms. The blood pressure was 104/72. She still showed some fatigue on exertion as in climbing stairs.

### TYPE 3. *Calcifications in the Renal Pelves*

**CASE 5.**—Mrs. N. T., aged 46, came to the Urological Clinic in March, 1938, complaining of attacks of kidney colic for ten years. She had had a stone removed from the right kidney in 1936. The attacks occurred once or twice a year but not until 1936 had there been an associated infection. She had passed stones from the left kidney a few days before admission. There were no skeletal symptoms other than rare pains in the wrists and knees but she had noticed increased fatigability for two or three years.

Physical examination was normal except for the following: Blood pressure 200/130. Hemoglobin was 80 per cent. The skeletal system was grossly normal, the thyroid was small and no nodules could be palpated. The heart was slightly enlarged. Tenderness on pressure was elicited in the left flank and costovertebral angle. The blood urea was 56 mg. A catheterized specimen of urine was grossly bloody and showed an occasional bacillus. Flat x-ray plates of the abdomen taken elsewhere showed large calculi in both kidney pelves and small calculi in the calices. X-rays of the long bones showed normal bone calcium deposit.

**OPERATION:** On March 15, 1938, an adenoma of the parathyroid in the right upper neck was removed. It lay between the trachea and the upper pole of the thyroid and measured 2 by 2 by 0.8 cm. The vascular pedicle came from the ascending branch of the right inferior thyroid artery. Microscopic section showed the cells to be of the Wasserhelle type.

**CONVALESCENCE:** The postoperative course was uneventful, without evidence of tetany. On March 28, left pyelolithotomy was performed. Convalescence from this operation was also uneventful except for some paralytic ileus and fever due to bilateral pyelonephritis.

### TYPE 3. *Calcifications in the Renal Pelvis and Parenchyma*

**CASE 6.**—Mrs. L. J., aged 54, came into the hospital on Aug. 24, 1938, complaining of burning pain on urination and cramping pains in the lower abdomen of one year's duration. She had had pellagra in 1930 and for the past few years increasing nervousness and swelling of her neck had been observed.

During the previous year, in addition to her complaint, she had had polyuria and nycturia (5 to 6 times). She had had many severe chills and elevation of temperature. She had lost 40 pounds during the past four years, was extremely nervous and "ate all the time." She had had some difficulty in swallowing due to thyroid enlargement. She was acutely ill, with fever.

Physical examination showed a fairly well developed and nourished white woman of 55. There was evidence of recent loss of weight. The blood pressure was 118/88. Hemoglobin was 59 per cent. No bone deformity nor tenderness over the spine was elicited on first percussion.

The thyroid showed a nodular enlargement involving the isthmus and both lobes. There was a fine tremor of the extended fingers. The pulse was 85. The heart was not enlarged. Abdominal examination showed a small umbilical hernia and tenderness on pressure over the bladder.

The urine was cloudy with 2+ albumin. There were 20-25 white blood cells per high power field and occasional red blood cells. Cocci were seen on stained smear. Phenolsulphonphthalein test showed an appearance time of five minutes and an excretion for half hour periods of 20, 12, 10 and 10. Blood urea was 48 mg.

Pyelograms showed on the right an enormously dilated ureter with numerous kinks. Both kidneys were markedly enlarged. Overlying each renal pelvis were several large densities. The lumbar spine and sacroiliac joints showed advanced hypertrophic change.

The patient was thought to have a tumor of the parathyroid gland but was not considered to be in condition for operation. While on the Urological Service she was treated for pyelitis with ureteral drainage and sulfanilamide. Her temperature remained elevated, she became progressively more drowsy and comatose and died in uremia with a high fever eighteen days after admission.

**AUTOPSY:** This showed an adenoma, chief cell type, of the left inferior parathyroid gland, weighing 3.2 Gm. and measuring 2 by 1 by 1 cm. The right inferior parathyroid was also enlarged and weighed 1 Gm. No other parathyroid tissue was found. In addition to calcification of renal tubules and interstitial tissues, bilateral renal calculi, obstruction of right ureter by calculus, bilateral pyelonephritis, right hydro-ureter and acute ureteritis, there were noted acute hemorrhagic cystitis, toxic nodular goiter, cholelithiasis, arteriosclerosis and myocardial hypertrophy.

The final conclusion was that we were dealing with parathyroid hypertrophy rather than with neoplasia.

#### TYPE 3. *Calcification in the Renal Parenchyma and Pelvis*

**CASE 7.**—Mrs. H. D., aged 44, experienced her first symptoms from the kidneys. Eighteen years previously she had suffered from kidney colic on the right side and had passed a stone. Four years later she had had a similar attack on the left side. Since that time she had had attacks of pain in the right flank about every two months. These pains were not as severe as the kidney colic, and were not accompanied by hematuria or by chills and fever. For ten or twelve years she had noticed polydipsia and polyuria. She could not say how much water she drank but estimated it as about twice as much as anyone else and said that her friends often remarked at the large amounts she drank. She suffered from nycturia (2 to 3) and would drink a full glass of water each time she arose. For fifteen years she had suffered from aching pains in the lower portion of the back, aggravated by motion. For six years she had noticed gradually increasing weakness and fatigability. For two years she had been nervous and for one year her memory had been poor, visual and auditory acuity diminished, appetite poor and she had lost weight steadily until at the time of examination here she weighed only 90 pounds.

On examination she was a thin, tired-looking woman, 50 pounds under her calculated ideal weight. The skin was dry and inelastic. The blood pressure was 140/100. Both kidneys were palpable, neither was tender. The cervix was lacerated, the uterus in retroposition and the perineum lacerated and relaxed.

Plain x-rays of her kidneys showed multiple punctate calcifications in the parenchyma which outlined the calices, giving the picture typical of hyperparathyroidism. X-rays of the bones showed no decalcification, cysts, tumors or other detectable abnormality.

Blood calcium was 15.4 mg., phosphorus 2 mg. and phosphatase 2.4 Bodansky units.



Urine from each kidney pelvis was sterile and neither pelvis was dilated on pyelography. There was rather marked nephroptosis on the right. The pthalein excretion was normal.

**OPERATION:** On Dec. 5, 1935, a soft, brownish-red parathyroid tumor about 4 by 2 by 1 cm. in size was removed from under the superior pole of the right lobe of the thyroid gland. When this lobe was rolled medially no tumor could be seen or felt. Dissection was carried along the inferior thyroid artery until it entered the thyroid gland without encountering any abnormality. A branch of the inferior thyroid artery which coursed upward was then followed and the lower portion of the tumor uncovered. It was of the same consistency as the surrounding tissues and on palpation could not be detected. Because we felt this might be a case of diffuse hyperplasia of all the parathyroid glands the left side was explored immediately. The left superior gland was normal in every respect. Neither of the inferior glands could be detected. The tumor was then removed.

**COURSE:** The postoperative convalescence was uneventful. There was no evidence of tetany. Blood calcium and phosphorus levels promptly returned to normal. She left the hospital on the seventh postoperative day. We have thus far been unable to get her to return for postoperative studies.

**TYPES 2 and 3. Calcification in the Renal Parenchyma. Generalized Osteoporosis.**

**CASE 8.**—Mrs. N. B., aged 47, began suffering from attacks of kidney colic fifteen years before admission and throughout the next seven years had experienced such attacks of hematuria and passage of stones at intervals varying from twice weekly to every three or four months. Eight years previously she had begun suffering from chills and fever with her attacks. A year later she was found to have ptosis of the right kidney, and stones and pus in each renal pelvis. In June, 1929, several cortical abscesses in the right kidney had been drained, seven stones removed from the pelvis and it was suspended. Following this operation she was much improved for two years but after that had suffered from recurring attacks of pyuria and pain in the region of both kidneys. She had suffered from gradually increasing weakness and fatigability for eight years, being unable to do her housework or to walk more than two blocks because of weakness for six years. For six or eight years she had noticed at intervals pains in the neck, back and both legs which she had attributed to neuritis. Within the past six months these pains had been much more frequent and severe, and during this time she had been nervous, her memory poor, her vision frequently blurred, her appetite had failed and she had lost 15 pounds in weight.

On examination she was a rather small woman, 26 pounds (12 Kg.) under her calculated ideal weight. The general physical examination showed no significant abnormality except for the presence of a small movable nodule about 2 by 2 cm. in size over the right lower lobe of the thyroid gland.

When first seen at the Duke Hospital on Nov. 14, 1935, she was thought to be suffering from hyperparathyroidism.

X-rays showed a rather diffuse mottled decalcification of all the bones. There were no cysts, tumors, or bony deformities. Both kidneys showed punctate areas of calcification outlining the calices.

Blood calcium was 14.9 mg., phosphorus 2.1 mg., and the phosphatase 5.5 Bodansky units.

The bladder urine contained innumerable pus cells and gram positive cocci. In addition to the multiple calcifications in the parenchyma of each kidney, as previously noted she had a bilateral hydronephrosis, nephroptosis with kink-



ing of the ureter at the ureteropelvic junction on both sides, and bilateral pyelitis. The urea clearance test showed an impaired kidney function. There was failure of concentration of urine on the Mosenthal test. The phthalein excretion curve was low. The n. p. n. was 33 mg.

**OPERATION:** On November 25, the nodule which was felt in the neck was found to be a small adenoma of the thyroid. As soon as the right lobe of the thyroid was reflected medially a firm rounded tumor could be palpated under the superior pole between the carotid sheath and the trachea. By incising the areolar tissue over this a well-circumscribed, firm, yellowish brown oval tumor about 2 by 1.8 by 1.5 cm. in size was brought into view. It was attached inferiorly by a vascular pedicle to a branch of the inferior thyroid artery. It was readily removed. Frozen sections reported immediately showed that it was a parathyroid tumor. Frozen exploration of the neck on each side did not reveal any other tumors.

**COURSE:** The postoperative convalescence was uneventful. She complained of tingling sensations in the hands on the third and fourth days after operation. The calcium and phosphorus levels promptly reverted to normal following operation. She left the hospital on the eighth day feeling better than she had in years. One month later she gave a history of having had psychic disturbances for three weeks. There was no evidence of tetany and the blood calcium was not at a tetanic level. It was felt that the symptoms were caused by the menopause. Theelin was administered. When last seen four months after the operation she was feeling better than she had for six or eight years. Neuritic pains had disappeared. Strength and appetite had improved, she was no longer nervous, there had been no evidence of the emotional unbalance for several months and she had gained 17 pounds in weight. However, she had had several attacks of pyelitis. X-rays showed no apparent recalcification of the bones and no change in the renal calcifications.

**TYPES 2, 3 and 4. Calcification in the Renal Parenchyma**  
*Generalized Osteoporosis, Parathyroid Hormone Intoxication*

**CASE 9.**—Mrs. A. A., aged 49, was admitted complaining of pain in the right chest and a feeling of tiredness. She had been admitted to another hospital on two occasions; first in 1926, with pyelitis, and the second time, in 1932, when a diagnosis of hydronephrosis on the right, with calcareous deposits in both kidneys, was registered. At this time blood chemical studies revealed calcium 12 mg., sugar 100 mg., urea nitrogen 30 mg., creatinine 2 mg., and non protein nitrogen 50 mg. Phenolphthalein excretion: 35 per cent in 1 hour with a total of 43 per cent in 2 hours. The urine showed a few hyaline casts, many leukocytes, and a few red blood cells.

Roentgen ray pictures of the kidneys taken in 1932 showed the diffuse mottling of the parenchyma which is now regarded as characteristic of hyperparathyroidism.

From 1932 until May, 1936, she had been apparently well with a good appetite and doing her own housework. She had then begun to have dull pain under the right shoulder blade which persisted off and on until May, 1937, at which time she developed a pain in the anterior chest on the right, at about the level of the third rib. During June, July and August, 1936, she became very weak, remaining in bed at one time for two weeks, and, despite an unflaggingly good appetite, she constantly lost weight. During the preceding twelve months her weight had decreased 30 pounds. She had not been nervous, she had slept well, and had had no pain except in the right chest as described. No polydipsia or polyuria had been noticed.



Physical examination on Sept. 21, 1937, revealed a small, undernourished white woman who did not appear at all ill, and who was pleasant, alert and cooperative. Temperature 38.2 degrees C., pulse 120, respirations 22, and blood pressure 148/90. At the left lower pole of the thyroid there was a round, firm nodule, about 2 cm. in diameter. A rather indefinite mass, thought to be kidney, was felt in the right hypochondrium. The physical examination was otherwise negative. The blood on admission was erythrocytes 3,500,000, hemoglobin 10 Gm. (66 per cent), leukocytes 6,200, differential count not abnormal. The specific gravity of the catheterized urine was 1.012, with a trace of albumin and 10 white blood cells per high power field. No electrocardiographic study was made.

The correct diagnosis was not suspected until a roentgen plate was made of the kidneys. This showed the kidneys to be low, and both filled diffusely with a mottled deposit of calcium, typical of the changes seen in hyperparathyroidism. All the bones showed generalized loss of calcium.

On the fourth day after admission, the blood chemistry findings were as follows: calcium 20 mg., phosphorus 4.7 mg., and refractive index 1.3492. The nodule at the left pole of the thyroid was now suspected of being a parathyroid tumor, and the patient agreed to an operation. She had been quite cheerful and uncomplaining, but during the next few days became rather depressed and complained a great deal of weakness and pain in the chest.

The blood chemistry on the seventh day after admission were: Ca 22 mg., P 4.8 mg., phosphatase 23 Bodansky units, plasma n. p. n. 58 mg., total protein 6.2 Gm. A phenolphthalein excretion test on September 28 showed 20 per cent excretion of the dye in 30 minutes and a total of 40 per cent in 90 minutes.

Ten days after admission, it was noted that the patient was nervous and hoarse and she complained of feeling very weak. The temperature was 38.5 degrees C., pulse 120. It was thought advisable to postpone operation. The patient had had a slight fever daily up to 38 degrees C., but on the last two days of life this had increased to 38.5 degrees C. Throughout her stay the pulse was accelerated out of proportion to the fever. The last note on October 2 was as follows:

"For the past 48 hours the patient has changed remarkably in her reactions. She has complained of great weakness and nervousness and, in contrast to her former cheerfulness, has been quite tearful. The rise in temperature of the past two days has been attributed to a possible upper respiratory infection. Tonight she complained of generalized aching pain. This morning at about 3 a. m. she called the nurse, who found her gasping for breath and quite cyanotic, and she died within a few minutes."

AUTOPSY: A complete examination was performed and the anatomic diagnosis was as follows: "Cystic and partly calcified and necrotic tumor of the parathyroid gland (lower left pole of thyroid). General intoxication (parathyroid hormone) with widespread injury necrosis and calcification of the connective tissue, especially that forming the basement membrane of the parenchymatous organs and the arteries of medium and arteriolar size. Extensive myocardial injury and necrosis. Chronic tubular and glomerular nephritis with extensive medullary calcium deposits. Hepatic focal necrosis."

Calcification was present in the kidneys and myocardium to a marked degree, together with widespread evidences of injury to connective tissue throughout all the organs. This was seen most conspicuously in the basement membranes of the parenchymatous organs, associated with cell necrosis and calcification. Calcium deposits were also present in the stomach and lungs to

a slight degree. There was widespread calcification of the media of arterioles in the heart, kidneys and lungs.

\*Reported by Dr. F. M. Hanes (ref. 35).

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## REVIEW OF HIRSCHSPRUNG'S DISEASE

### With Report of Case Treated by Presacral Sympathectomy

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#### HIRSCHSPRUNG'S DISEASE

Definition, History, and Synonyms  
Etiology  
Signs and Symptoms  
Pathology  
Diagnosis  
Course and Prognosis  
Treatment  
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Bibliography

#### DEFINITION, HISTORY AND SYNONYMS

**P**ROBABLY the best definition of Hirschsprung's disease is that given by Hirschsprung himself in 1886 when he described it as "a condition of congenital high grade dilatation of the colon with thickening of all its tunics, especially the tunica muscularis, and retention of large quantities of fecal matter." While at least twenty cases had been previously reported, his discussion and description of the condition definitely established it as a clinical entity and warranted the use of his name in the designation of the disease.

It is rather generally accepted that the first case reported was that of a five year old girl observed early in the seventeenth century by Ruysch and that Bright in 1836 performed the first operation for the condition. In our own country a Philadelphia physician, Dr. William E. Hughes, reported an autopsy case of a three year old boy, one year before Hirschsprung. Italians indicate their priority claim by designating the condition as "Mya's disease." Other terms applied are "phantom tumor," "megacolon," "megalacolon," "congenital idiopathic dilatation of the colon," "primary idiopathic megacolon," and "neuropathic dilatation and hypertrophy of the colon." In view of recent contributions the latter term is probably the most accurately descriptive. Certainly "phantom tumor" is a very poor designation and "megacolon" or "megalacolon" are entirely too general and all-inclusive to serve as satisfactory terms.

#### ETIOLOGY

Until recently the number of theories advanced and classifications suggested offered rather definite proof of the inadequacy of any

of them to explain satisfactorily the etiology of the disease. Congenital causes included, rather loosely, ill-defined developmental defects. Obstructive lesions were suggested as being either anatomic, as evidenced by elongation of mesentery or colon, or actual mechanical obstruction; or nervous, due to paralysis, neuromuscular defects, or spastic contraction of the anal sphincter, or the imperfectly formed rectosigmoid sphincter of O'Beirne. The infection theory was probably incorrectly based upon the presence of colonic ulceration which in reality is the result rather than the cause of the disease. The belief that endocrine imbalance is an etiologic factor is based upon the fact that many of the patients show evidence of hypofunction of the thyroid, pituitary and gonads and that in the embryo hypothyroidism is believed to cause impaired tissue differentiation. The etiologic importance of such imbalance may be further substantiated by the frequent association of mental deficiency, other congenital defects, and a familial tendency which includes even the occurrence of the disease in twins.

However, at the present time, most authorities believe that the condition results from a distorted balance between the sympathetic and parasympathetic nerve fibers with a preponderance of the sympathetic impulses. This view began with the accidental observation of Wade and Royle that after sympathectomy for spastic paraplegia constipation was usually relieved. The successful treatment of Hirschsprung's disease by some form of sympathectomy and the experimental production of the disease in a cat by the severance of the parasympathetics lent support to this theory. The comparative rarity of the disease as compared to the incidence of hypofunction of the endocrines would seem to indicate that the unbalanced nerve control resulted not from change in internal secretions but from an accidental mechanical factor during the migration or rotation of the embryonal gut tube. Whatever the factors are they are probably prenatal as the disease usually manifests itself within the first few weeks or months of life and has been found not only sufficiently developed to interfere with delivery but also to be well demonstrable in a seven month fetus. Cases observed after maturity will usually give some symptoms, though mild, dating back to early childhood or will prove to be a megacolon secondary to some obstructive cause. No explanation has been offered as to why the disease appears about three times more frequently in males.

#### SIGNS AND SYMPTOMS

The characteristic symptoms are obstinate constipation and distention of the abdomen occurring shortly after birth. The constipation is extreme. Frequently defecation may occur only every three or four weeks and has been reported to occur as rarely as once in

three months. Catharsis and enemas produce very unsatisfactory results. At times an intermittent diarrhea appears, the watery discharges passing around the retained dry fecal matter. When stools do occur they have a very foul odor.

The distention gives a pot-bellied appearance and may be so marked that the circumference of the child's abdomen may exceed his height. There is decided bulging of the sides of the lower part of the chest and the intercostal angle is much widened. The overlying abdominal wall is thin and the superficial veins frequently enlarged. Visible peristalsis is easily observed and borborygmus is audible. There is little if any tenderness and vomiting is uncommon. While the excessive pressure often causes dyspnea, circulatory failure and ureteral obstruction are rare. Diastasis recti and hernia may result from increased pressure or maldevelopment. Stercorremia causes a severe chronic toxemia with dried skin, dull facies, impaired nutrition and retarded mentality.

#### PATHOLOGY

The gross pathologic changes are dilatation and hypertrophy of one or more segments of the large bowel usually with elongation of the involved portion of the colon and the corresponding mesentery. The sigmoid is the most commonly involved but any combination of segments is possible. The change from normal proximal bowel to the distal involved portion is usually gradual, although it may be abrupt, but the transition distally from the affected portion to the normal is nearly always abrupt. The disease never extends beyond the ileocecal valve. The amount of retained feces may be enormous—as much as 47 pounds having been removed. Ulceration of the mucosa is frequent, probably due to the presence of hard fecal material.

Microscopically the wall of the affected intestine will show stretching of the mucosa and thickening of it and both muscular layers, the longitudinal and circular being about equally affected. Little change is observed in the serosa. The pressure exerted by the distended bowel may cause hydronephrosis, pedal edema, hernial protrusion, bowel rupture and dyspnea. Examination of resected sympathetic nerve trunks show no gross or microscopic change. Anemia may result either from impaired digestion or absorption of toxic material in the intestinal tract. Pulmonary embolism has occurred during straining at stool.

#### DIAGNOSIS

As a rule the diagnosis is not difficult: it should be suggested by the chronic constipation and abdominal distention occurring in or from very early life. When a sigmoidoscope is introduced into a

distended segment it seems to fall in without meeting any resistance. The roentgenologic findings after a barium enema are conclusive and may be further confirmed by the contraction of the dilated bowel after spinal anesthesia, procaine injection of the lumbar sympathetic chain, or administration of acetylcholine.

The diseases most likely to be confused in differential diagnosis are rickets, tuberculous peritonitis, and tumors. While Hirschsprung's disease presents the pot-belly of rickets, none of the skeletal changes of the latter are present. Tuberculous peritonitis causing much abdominal enlargement is usually accompanied by demonstrable ascitic fluid. The more common tumors, while giving rise to considerable distention of the abdomen, will not cause enlargement of the coils of intestines, and those involving the kidney may be diagnosed by pyelograms.

#### COURSE AND PROGNOSIS

While the disease, especially in its milder stages, is not incompatible with life its course is usually progressive and toxemia or obstruction may bring about an acute crisis with fatal results. Active treatment of some kind is therefore always indicated. The modern surgical treatment carries a very small mortality and the percentage of symptomatic cures is high.

#### TREATMENT

When surgical treatment was limited to cecostomy or colostomy for drainage and irrigation in volvulus and other obstruction, ileosigmoidostomy for short-circuiting around an involved segment, and colonic resection, single or multiple, to remove distended loops, there was perhaps room for argument as to the advantages of surgical over medical management of the disease. Although it was realized that medical treatment was only palliative and never cured, it was used in the milder cases and in those observed rather late in life. It consisted of massage, catharsis, irrigations and low residue diet. With an appreciation of the nervous imbalance other recent treatments advocated to stimulate the parasympathetics include the application of heat in the form of diathermy or rectal irrigation of saline at 115 degrees F. and the use of drugs such as insulin, eserin, hypertonic saline, pituitary extract, and acid-forming substances. However, even before sympathectomy, Finney stated that the surgical mortality was only two-thirds of the medical and the number of cures three times as many.

Although one cannot but admire the courage of those who have attempted to resect these dilated and hypertrophied segments of colon, such surgical daring can no longer be commended. Presacral

sympathectomy and even lumbar ganglionectomy are so much safer and so much more physiologic in their approach that now the indications for partial or total colectomy are nil.

The presacral nerve derived from the inferior mesenteric plexus and the lumbar sympathetic chains contains the sympathetic fibers that inhibit contraction of the colon (particularly the left side), increase contraction of the anal sphincter, carry painful impulses from the female internal genitalia and inhibit bladder contraction. (This latter function accounts for the temporary frequency of urination that follows resection of the nerve.) This nerve lies in front of the promontory of the sacrum behind the posterior layer of the peritoneum at the bifurcation of the aorta. It is not difficult to expose and resect if the distended colon can be retracted. This is aided by spinal anesthesia. The nerve should be removed from below upwards being careful to clamp and ligate distally to avoid troublesome bleeding from the small vessel that frequently accompanies it. The resection should be carried upwards to include both lateral branches from the inferior mesenteric plexus. The posterior peritoneum is then closed without drainage as is the incision in the anterior abdominal wall. The unopposed or less opposed parasympathetic fibers then can bring about constriction of the colon and relaxation of the anal sphincter. Although the distention and hypertrophy will not be entirely cured, marked symptomatic relief usually follows and recurrence does not result as it often does after resection which fails because it is an attempt to restore physiologic equilibrium to an organ that does not have expulsive power.

If presacral sympathectomy proves to be inadequate, as it may in extensive cases or those with more involvement of the right colon, it may be supplemented by lumbar ganglionectomy on one or both sides. While this latter is more certain and extensive in its results it is also a more hazardous surgical procedure and the circulatory changes in the lower extremities are undesirable. For these reasons it should probably be reserved for the obstinate cases. Regardless of the type of surgical procedure selected preoperative medical treatment for decompression of the distended bowel is of great value.

#### CASE REPORT

A school-boy 17 years of age was admitted to St. Joseph's Infirmary on Oct. 16, 1936, complaining of extreme constipation and a big "stomach."

*Family History.*—His mother was dead, unknown cause. His father was living and in good health except that he was incapacitated by a leg injury sustained in the War. There were four sisters, all in good health, and no brothers living or dead. So far as he knew there was no tuberculosis, cancer, glandular disturbance, diabetes, or congenital defects in his immediate family, and he knew of no relative who had trouble similar to his.



*Previous History.*—The patient had had the usual childhood diseases without complications. The present complaint had existed since infancy.

*Present Illness.*—Since infancy he had had difficulty getting his bowels to move and had always had an abnormally large abdomen. Bowel movements had been irregular, most infrequent, and, when voluntary, in very small amounts. Cathartics were ineffectual and unsatisfactory. Fairly good evacuations occurred after enemas, one to three of which were taken weekly with moderate relief. At times there had been no evacuations for periods as long as three weeks. Nausea and vomiting occurred when the bowels were not

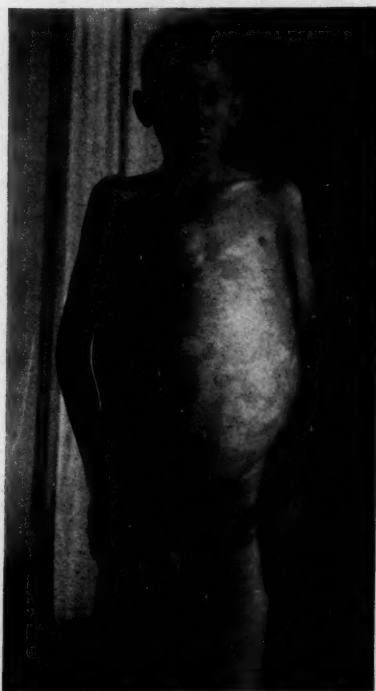


Fig. 1. Photograph of the boy at the time of admission. The face is pinched and drawn, the neck scrawny. The general state of nutrition is poor and the muscular development equally poor. There is no pubic hair. The costal angle flares out and the abdomen is tremendously distended.

emptied frequently. The patient had some dyspnea on exertion and was unable to participate in the usual school activities. He was frequently disabled because of rather severe pain in the left lower quadrant. There had probably been some mental as well as physical retardation as he had reached only the eighth grade at 17 years.

*Physical Examination.*—His general appearance resembled that of a little old man. The hair on his head was grayish in scattered areas. His face was pinched and drawn and his neck scrawny. The upper chest was small and the lower chest at the costal margin flared outward. The abdomen was tremen-

dously distended. Both arms and legs were somewhat smaller than normal but grossly out of proportion to the trunk. There was a light brownish pigmentation over the abdomen and arms. On admission his temperature was 99 degrees, pulse 70, and respiration 28.

The heart was pushed upwards and the sounds, most audible to the right side of the chest, were normal. Blood pressure was 130/90. Both lungs were clear. The liver dulness reached the fourth interspace. The chest measured 31 inches at the level of the tenth rib.

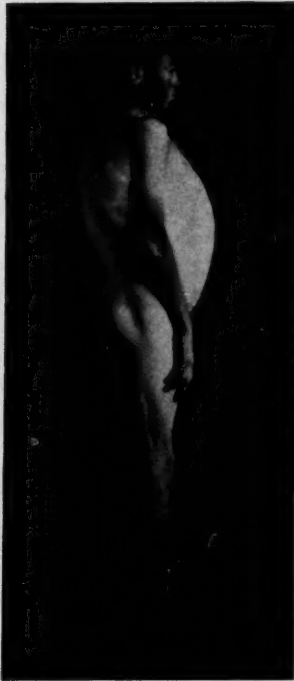


Fig. 2. Side view of the boy before operation.

In addition to the gross distention of the abdomen previously mentioned, distended coils of the colon were easily visible, the transverse colon and sigmoid being particularly prominent. In the latter a fecal mass could be palpated. Peristalsis was both visible and audible.

Rectal examination showed normal sphincteric tone and no evidence of obstruction, but the rectal wall was thick and rough.

The reflexes were normal.

*Laboratory Findings.*—Oct. 16, 1936. Urinalysis was essentially negative. Blood—Hemoglobin 91 per cent, red cells 4,820,000, white cells 8,800. The differential count was not significant.

*X-ray, Barium Enema.*—Approximately two quarts were required to fill the left half of the colon: it was thought inadvisable to put more barium into

the colon. Conclusion—"The examination is indicative of congenital megacolon."

October 19, X-ray: "Film of the abdomen with patient in the erect position shows barium diffused throughout the greatly distended colon. There is no other evidence of abnormality."

*Progress.*—On the 19th, the patient was given 80 mg. of novocain as a spinal anesthetic. Definite peristaltic waves were set up and gas passed but no stool. Abdominal circumference then was 35 inches, 2 inches less than before anesthesia.

October 21, operation was deferred since spinal anesthesia was not effective. Administration of pitressin was begun (1 c.c. doses).

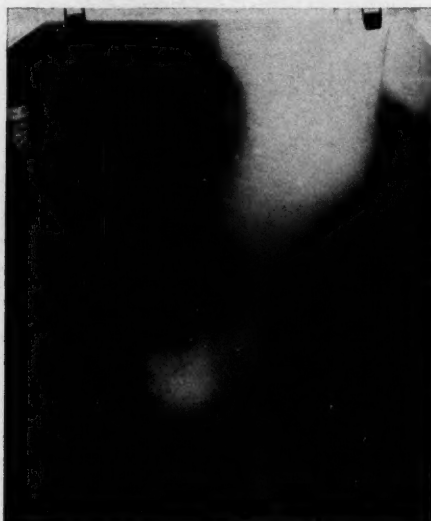


Fig. 3. Barium enema showing the enormous dilatation of the left colon.

October 25, pitressin was discontinued because of nausea.

October 26, the boy was operated upon under 140 mg. of novocain injected in the second lumbar interspace. A left rectus incision was made from 3 inches below to  $1\frac{1}{2}$  inches above the umbilicus. Exploration showed tremendous dilatation and hypertrophy of the colon extending principally from the hepatic flexure to the anus with very little dilatation of the appendix and cecum. The wall of the involved bowel was approximately  $\frac{1}{8}$  inch in thickness. The appendix was elongated but of normal caliber. Coils of intestines were retracted to expose the promontory of the sacrum and a longitudinal incision was made in the posterior parietal peritoneum extending from the promontory upwards for  $2\frac{1}{2}$  inches. The presacral nerve was identified, ligated and incised at its lowest portion. The nerve was then dissected upward towards the inferior mesenteric plexus and the resection of nerve tissue was completed by cutting through the two large lateral trunks of the plexus as well as by cutting some of the small branches below this level. The posterior peritoneum was then closed with intestinal suture and the abdominal wound in layers with plain

and chromic catgut, dermal for the skin and four retention sutures. No drainage was used. (Cyclopropane was required for the skin closure.)

Pitressin was resumed in .5 c.c. doses. The patient reacted nicely except for some elevation of pulse. The abdomen was immediately softer and marked frequency of urination began.

October 30: The greatest circumference of abdomen over dressing was 35 inches. Mineral oil and low residue diet were prescribed.

October 31: Excellent results were obtained from enema.

November 2: He expelled large quantities of gas.

November 4: The abdomen was noticeably softer.

November 5: Dressing was changed and wound was clean and dry. The peristaltic waves were evident and gas was passed freely.

November 7: Frequency of urination persisted.

November 10: The abdomen was almost flat at times but at other times somewhat distended.

November 12: The patient was discharged from the hospital, wound entirely healed. The abdomen was definitely smaller and noticeably softer. He was much more comfortable than before operation. He received better results from enemas than ever before. Much less dyspnea was present.

After discharge from the hospital he was seen about once a month for eight months. He reported that he rarely required an enema and needed less and less mineral oil. He had satisfactory stools for the first time in his life. His facial expression became less drawn. He was able to play at usual sports and was decidedly more comfortable in every way. Most of the time his abdomen was not especially distended. The urinary frequency subsided to approximately normal.

He then moved to a neighboring state and continued to enjoy improved health until he died of an acute illness Sept. 20, 1937, eleven months after operation. The attending physician was not sure of the exact cause of his death but did state that it was unrelated to the previous Hirschsprung's disease.

#### SUMMARY

The present concept of Hirschsprung's disease is that it is due to a developmental lack of balance between the sympathetic and parasympathetic fibers supplying the colon and that the preponderance of impulses is sympathetic. While medical treatment may be tried in the very young patients and in milder cases in older children, presacral sympathectomy is so effectual and so free of mortality and morbidity that it would seem to be the treatment of choice. Sympathectomy of the lumbar chains, because of its more formidable nature and the subsequent changes in the extremities, should be reserved for cases not responding satisfactorily to the simpler surgical treatment. Colonic resection would seem to be but rarely indicated because of its inherent dangers and colostomy is needed only for acute obstruction. An illustrative case report has been given.

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# The Southern Surgeon

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## THE SOUTHERN SURGEON A MONTHLY!

THE SOUTHERN SURGEON made its first appearance in April, 1932. Founded largely to publish the papers read before the Annual Assemblies (now the Postgraduate Surgical Assemblies) of The Southeastern Surgical Congress, it was also designed to stimulate Southerners to write good surgical papers. In that first number was announced its platform:

THE SOUTHERN SURGEON, like a well-known railway, is designed to serve the South. In its cover of Confederate gray, it will be boldly, thoroughly and unashamedly Southern. Yet, conceived with malice towards none, it will not be provincial. Particularly during its first year, THE SOUTHERN SURGEON will publish many papers by men who are not so fortunate as to live in the South, but it will never publish bunk by the most out-and-out, dyed-in-the-wool Southerner.

It does aim to provide surgeons of this region with excellent papers, and it hopes particularly to enlist their interest by showing them what their neighbors are doing. One of its chief purposes, moreover, is to encourage the younger men. As Dr. Haggard wrote, in accepting a place on the Editorial Advisory Board,

"It will be a great stimulus to the young men to perfect their work, to record it, and to make the additional studies that are so important in the preparation of medical papers and case reports and are of such paramount value to the man who studies them."

April 1932 was just about the nadir of the Great Depression. Many fears were expressed as to the success of the undertaking. It was necessary to make a modest beginning, and the SURGEON appeared only quarterly for three years: we shall never forget that at the time the Assembly was convened in 1933 every bank in

the country was closed. But a quarterly was not enough: it barely provided space for the Assembly papers, and it allowed too many people to forget all about the journal between its infrequent appearances. In 1935 therefore, it was issued every second month. It has become increasingly clear that this was not enough.

Dr. Fred W. Rankin, President of the Congress in 1937-38, urged a monthly in season and out; sometimes it seemed to the active Editors that he thought the only reason for the delay was their innate perversity (Note: The Managing Editor abhors red ink worse than Nature abhors a vacuum, and the Editor, an old-fashioned Southern Democrat, has an equal abhorrence of an unbalanced budget), but his incessant proddings did further fire their zeal for a monthly. Dr. T. C. Davison, President 1938-39, wouldn't let up either; during his administration too the Congress experienced a healthy growth, and this brought the day nearer. Finally, Dr. R. L. Sanders, who became President last March, visited Atlanta the first of December in the interests of monthly publication. He not only insisted that the *SURGEON* must come out every month but also volunteered a substantial sum of money against the deficit that is to be feared during the first year as a monthly.

To publish a successful magazine it is necessary to have subscribers and advertisers. The more subscribers you have, the more advertisers you can get; the more advertisers you have, the better the journal you can publish; the better the journal you publish, the more subscribers you can get. At the same time, a professional journal must exert the utmost care not to accept advertising from any but firms of unquestioned integrity. Merely to secure medical advertising would be a cinch. We must pause to pay tribute to our staunch friends, Johnson and Johnson, Davis and Geck, and the Bard-Parker Company, who have been with us from the beginning, and to our newer friends, Ciba Pharmaceutical Products, Inc., the Clay-Adams Company, the General Electric X-Ray Corporation, the Westinghouse X-Ray Company and William P. Poythress and Company.

The *SURGEON* started with a list of about 300 subscribers. Its growth has never been spectacular, but it has been constant and its circulation has increased approximately 700 per cent in eight years. Now that we have slightly more than 2,000 subscribers (and the second thousand was not nearly so hard to get as the first), we hope that the journal will be able to stand on its own feet in 1940. Anyway, the die is cast, the Rubicon is crossed and we are going off the deep end.

## POSTSCRIPT

The Editor's favorite lay magazine is *Time*: often in it he first learns of news in medicine. In its issue for December 18, *Time* quotes liberally from an address by Sir Robert Hutchison recently published in the *Lancet*. All of it is worth reading, but here only excerpts can be given:

"The great majority of us are snowed under by an avalanche of medical journals. Too many doctors choke their offices with unopened magazines 'useful to throw at the cat.'... Facts may be said to be buried rather than recorded."

To check the avalanche, control the "verbal diarrhea," "mental exhibitionism," and "itch for advertising" of many medical writers, Sir Robert suggested: 1) "strict birth control in regard to new journals," strict "suppression" of many old ones; 2) tougher editing ("almost everything is too long."). Above all, he said, there should be no publication of "memorial lectures, such as this one... There are surely better ways of remembering the dead than by boring the living."

There is a lot of truth in what Sir Robert said.

Let it be noted here and now that the Editorial Council (which passes on papers accepted for publication), the Managing Editor and the Editor of THE SOUTHERN SURGEON will not necessarily publish every paper that is submitted, and that the Council has instructed the Editor to use his blue pencil even more freely, to delete words, sentences and paragraphs that are not necessary. A monthly edition of the SURGEON will not mean a padded journal—even though some numbers may appear skimpy. At the same time a welcoming hand will always be extended to virgin authors: they are requested to read again the remarks made by Dr. Haggard nine years ago with regard to the destiny of this journal. We prefer to publish the unadorned original work of a man who is going places rather than to publish the most eloquent verbigerations of a famous has-been.

## BOOK REVIEWS

*The Editors of THE SOUTHERN SURGEON will at all times welcome new books in the field of surgery and will acknowledge their receipt in these pages. The Editors do not, however, agree to review all books that have been submitted without solicitation.*

**NUTRITION AND DIET IN HEALTH AND DISEASE.** By JAMES S. McLESTER, M. D., Professor of Medicine, University of Alabama, Birmingham. Third Edition, Entirely Rewritten. 838 pages. Price, \$8. Philadelphia and London: W. B. Saunders Company, 1939.

The first edition of Dr. McLester's book, it has been said, was responsible for his being elected President of the American Medical Association. Certainly it has long been recognized as a classic and at the time it was published it was just about as good a book on the subject as could be written. With all due respect to that edition however, in the opinion of the reviewer it may be compared to the new one just about as a 1927 car can be compared to a 1940 model!

The first section takes up the physiology of nutrition, with a most sensible discussion of the vitamins (do some of us get much of our knowledge of these most important substances from the detail men and the advertising literature?). The second section discusses the individual foods, the third diet in health, including a chapter on the feeding of infants by Dr. P. C. Jeans, Professor of Pediatrics at the State University of Iowa.

Part II contains chapters on the deficiency diseases, diabetes mellitus, gout, obesity and leanness, food poisoning and allergy, as well as on diseases of the kidneys, the digestive organs and other systems. Dr. Dean Lewis contributes a most valuable chapter on feeding the surgical patient.

Dr. McLester's book is not only a masterpiece covering the whole field of diet as of today, but, written by a Southerner, it pays particular attention to the kinds of food we people like to eat; it should therefore prove of unusual value to those of us who practice below that well known line. And, let it be noted, these days every doctor must know something about diet: his patients expect it, and if he can't advise them authoritatively they may go to some doctor who can, which is bad enough, or they may go to a charlatan, which is of course infinitely worse.

"Nutrition and Diet in Health and Disease" is recommended not only without reservation but with the greatest enthusiasm.

**CANCER OF THE LARYNX.** By CHEVALIER JACKSON, M. D., Sc. D., LL. D., F. A. C. S., Honorary Professor of Broncho-Esophagology and Consultant in Broncho-Esophagologic Research, Temple University Medical School, Philadelphia, and CHEVALIER L. JACKSON, A. B., M. D., M. Sc. (Med.), F. A. C. S., Professor of Broncho-Esophagology, Temple University School of Medicine, Philadelphia. 309 pages, with 189 illustrations on 116 figures, and 5 plates in colors, containing 50 illustrations. Price, \$8. Philadelphia and London: W. B. Saunders Company, 1939.

Fifty years ago it may have been permissible to treat a patient symptomatically for "chronic laryngitis" for an indefinite period: indeed an exact diagnosis often offered little hope that specific treatment would help. Such handling of chronic hoarseness today does not fall short of malpractice, and for this change the world is indebted to Chevalier Jackson more than to anyone else.

Carcinoma of the larynx we have learned in recent years constitutes some 5 per cent of all cancers. When recognized early, it can often be removed by the relatively simple operation of laryngofissure; Dr. Jackson contributed a splendid paper on this subject to THE SOUTHERN SURGEON in 1932, with 80 per cent of cures. Even though the cancer is not recognized till many months later, there is still an excellent chance of cure by the more radical removal of the whole larynx, and it has been abundantly proven that a man without a larynx may still enjoy life for many years: indeed sometimes he learns to preach or hold court without any artificial aids.

The Jacksons, not content with the knowledge that there are now a number of men in the South capable of operating successfully for laryngeal cancer, have presented this wholly admirable text to increase that number here as well as in other parts of the world. The book is conveniently arranged in three parts: procedures, general considerations including differential diagnosis, and historical. It is unnecessary to add that the illustrations are abundant and superlative, the majority having been drawn by Chevalier Jackson himself.

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**TUMORS OF THE HANDS AND FEET.** Edited by GEORGE T. PACK, B. S., M. D., F. A. C. S., Assistant Clinical Professor of Surgery, Yale University School of Medicine and Cornell University College of Medicine; Attending Surgeon, Memorial Hospital for Cancer and Allied Diseases. 138 pages with 94 illustrations. Price, \$4.00. St. Louis: The C. V. Mosby Company, 1939.

Tumors of the hands and feet are not common and yet, as has been stressed elsewhere, "with the exception of the so-called vital organs, the hand is functionally and economically the most important unit in the body." It is therefore of the greatest importance that such tumors should be accurately diagnosed as soon as possible and treated properly in order to prevent mutilating operations, incapacitating disabilities and even loss of life.

This symposium, which appeared in *Surgery* a year ago, will prove a most valuable work of reference and the profession should be grateful to the Mosby Company for re-issuing it in permanent form.

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**ELECTROCARDIOGRAPHIC PATTERNS: THEIR DIAGNOSTIC AND CLINICAL SIGNIFICANCE.** By ARLIE R. BARNES, M. D., Mayo Clinic, Rochester, Minnesota. 197 pages, with 94 illustrations. Price, \$5. Springfield and Baltimore: Charles C Thomas, Publisher, 1939.

It is hardly necessary for the surgeon to familiarize himself with all the vagaries of the electrocardiogram. However the wise surgeon will do well to have a colleague in internal medicine who is possessed of the knowledge in this field that may be gained from a careful study of Arlie Barnes' fine new monograph, the clearest and best exposition of the interpretation of cardiograms available today.

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**FRACTURES.** By PAUL B. MAGNUSON, M. D., F. A. C. S., Associate Professor of Surgery, Northwestern University Medical School, Attending Surgeon, Passavant Memorial Hospital and Wesley Memorial Hospital, Chicago. Third Edition, Revised and Enlarged. 511 pages, with 317 illustrations. Price, \$5. Philadelphia, London, Montreal: J. B. Lippincott Company, 1939.

This book is above all practical.



The very great majority of fractures must be taken care of either by the general practitioner or by the general surgeon. Neither is expected to be an expert on the management of ununited fractures; in general, neither should do too many open reductions. The reviewer believes that the conscientious man who commands the knowledge so clearly set forth in this volume should be able to handle adequately most of the fractures he will ever be called upon to treat. Such a surgeon may feel that some of the material is elementary, but harping upon the essentials never did anybody any harm, and a thorough understanding of the fundamentals is necessary for the inexperienced, i. e., the book is also suitable for undergraduates and interns. Finally, the book is well written, the print is large and clear and the illustrations are just right.

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INFECTIONS OF THE HAND. By LIONEL R. FIFIELD, F. R. C. S. Second Edition by PATRICK CLARKSON, F. R. C. S. Eng., Surgical Tutor, Guy's Hospital; Demonstrator of Anatomy and of Operative Surgery, Guy's Hospital Medical School. 166 pages, with 57 illustrations, including 8 plates (2 coloured). Price, \$3.25. New York: Paul B. Hoeber, Inc., 1939.

The importance of infections of the hand, as Dr. Maguire states elsewhere in this issue, cannot be overemphasized. It may require more skill to restore a useful hand to a manual laborer than to remove the gallbladder from a society dame, and the world may be more benefited when the laborer is restored to a life of economic independence than when the socialite is relieved of her indigestion.

This little book, which so conveniently fits the pocket, provides the essentials in concise form. Certainly everyone who handles infections of the hand should know what is in it: too often, it is to be feared, the recent graduate doesn't.

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SURGICAL APPLIED ANATOMY. By SIR FREDERICK TREVES, *Bart.* Revised by LAMBERT ROGERS, M.Sc., F. R. C. S., F. R. C. S. E., F. R. A. C. S., F. A. C. S., Professor of Surgery, University of Wales; Honorary Surgeon and Director of the Surgical Unit, Cardiff Royal Infirmary; etc. Tenth Edition. 748 pages, with 192 illustrations, including 66 in color. Price, \$4.50. Philadelphia: Lea & Febiger, 1939.

This hardy perennial appears again more than half a century after it was first written. "Such popularity must be deserved." Extensive revisions by Mr. Lambert Rogers however make the tenth edition quite modern: bronchoscopy and the use of lipiodol in mapping out the tracheobronchial tree, for example, are included.

The book is recommended to the undergraduate who may sometimes wonder why he must study anatomy, "to practitioners whose memory of their dissecting-room work is growing a little grey, and who would wish to recall such anatomical matters as have the most bearing upon the details of practice;" above all, it is recommended to those ambitious younger surgeons who are preparing for the examinations of the American Board of Surgery.

